

City of trees



CLEARINGHOUSE
中欧城市森林应对方案

Inspiration and activities to teach about the importance of
urban trees and forests



In cooperation with:



CLEARINGHOUSE
中欧城市森林应对方案



EFI



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Introduction: a word for the teachers

For the preparation of this Inspirational Package, we conducted a survey and collected over 130 results from across Europe. Respondents reported the lack of materials to teach about forests and trees; the lack of green schoolyards and general difficulty in teaching youth in the outdoors. It became clear to us that the importance of forests and the benefits of single trees in the cities are still too vaguely understood by the urban inhabitants, students, and teachers alike. How then do we make sure we manage to raise awareness on the importance of urban trees and forests for our own survival and that of the planet? How do we manage to bring up children and youth who will grow up to be active citizens who conserve and increase trees in the city?

Recent studies have revealed that going beyond activities that simply engage people with nature through knowledge and identification is needed. Our connection to nature needs to be reinforced. An individual's connection with nature may not only increase their overall wellbeing, but it can also influence their level of engagement in pro-environmental behaviors. Climate change and the pandemic have got many of us, including teens, suffering from anxiety. Strengthening our bond with nature can alleviate anxiety and empower to turn fear into positive action to fighting climate change, especially when coupled with concrete tools and activities to do so.

Five pathways to increased nature connection have been defined by University of Derby and these pathways provide a route for people to develop a new relationship with the natural world, a relationship which can move beyond utility and control, knowledge and identification. The 5 pathways (Meaning, Compassion, Senses, Emotion and Beauty) are illustrated on the next page. In this package we have marked each lessons with a selection of pathways that at least can be identified in the lesson. We invite you to reflect upon each pathway at the end of each lesson together with students.



Introduction: a word for the teachers



MEANING - nature bringing meaning to our lives, e.g. the first migratory birds in the spring, a sunset or sunrise...



COMPASSION - caring and taking action for nature, e.g. collecting trash in nature, helping a wounded animal..



SENSES - tuning in to nature through the senses, e.g. listening, enjoying the scents, feeling the textures, ..



EMOTION - feeling alive through the emotions & feelings nature brings, e.g. hearing the increased birdsong in the spring, experiencing a thunder storm or a blizzard,



BEAUTY - noticing nature's beauty, e.g. enjoying a breathtaking landscape, rainbow, a detail, scent, sound, music or piece of art depicting or inspired by nature...

5 Nature connection pathways
by University of Derby Nature Connectedness
Research group

Though cities and countries differ in terms of abundance of forest cover, the material that is provided in this document is developed for any city environment with any trees. Where necessary, feel free to adjust the content (e.g., the species of trees mentioned) to better match your local situation.

We have attempted to create a package that is accessible and useful even for teachers with little or no experience with trees. All that is needed, is a curious mind and willingness to explore.

We invite you to use this package and hope that it inspires you and your students to notice, value and protect the urban trees and forests now and in the future for the health of humans and the planet.



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Lesson #3: *Patterns in nature* 🌿🐦🧠

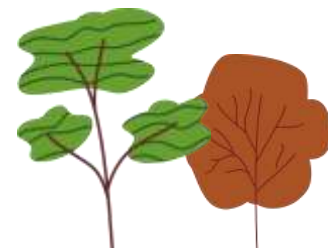
Lesson #4: *It all starts from a seed* 🌿❤️🐦🌱🧠

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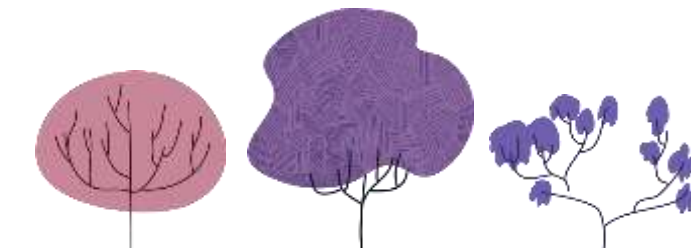
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#1 Noticing trees in the city

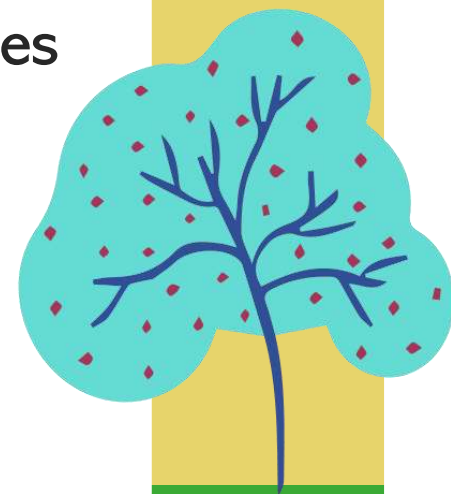
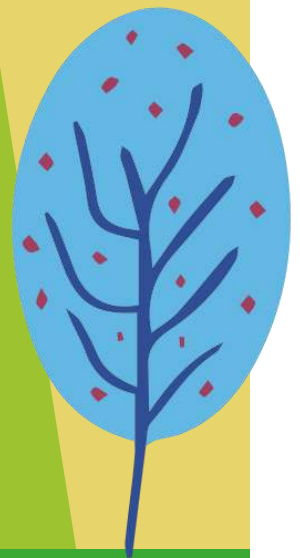


Description & background:

This lesson is perfect to start with. It touches upon concepts such as biodiversity and heat island effect. The students will start noticing different aged tree individuals around them. They will also visit some of these old trees, get to know them and compete to complete the tasks. This lesson is especially useful as a beginning exercise for other tree related exercises

Keywords:

Biodiversity, old tree, ecosystem services, heat island effect, urban pollutant, fine particulate



Goals for students:

Develops understanding of importance of different aged trees in the city. Builds the ability to notice trees as individual species in the city with specific benefits to human health. Student gains an understanding of trees functioning in the city; the different public bodies dealing with trees and green spaces; understanding that trees are vulnerable to people's choices.

Suitability:

Outdoors & indoors-
spring, autumn, summer.

Fits in subjects:

Biology, geography, ethics, arts, social sciences

What do you need?

Materials: Urban Tree Bingo cards; printer and scissors, or alternatively smartphones

Preparation: Print the Urban Tree Bingo cards. Decide what is the best way to work based on the group: do the students work in small groups during class? Do they use smartphones, or do they draw? Is this a homework assignment?

#1 Setting the scene

Unlike people, trees can grow to become as old as hundreds to over a thousand years old. Most trees do not grow fast, nor do they grow with all their organs intact. Trees recreate the materials they need for survival every year. Every year they produce leaves and seeds, whether they are young or old. It is rare for a tree to die of old age alone. Instead, it is the exposure to the stress of wind, disease, insects, pollution, soil erosion, soil compaction, weather, and people that will most likely cause a tree's demise.



The trees surrounding the city help to cool the city down.

#1 Setting the scene

The gentle giants have other special characteristics too. Trees in the city sequester carbon, which refers to the long-term removal and capture of carbon dioxide from the atmosphere. This in turn slows or reverses atmospheric CO2 pollution and mitigates (weakens) global warming. As a byproduct of tying up carbon, trees produce oxygen in the process called photosynthesis, which we living beings need to exist on this planet. This process sustains life on the planet.



Trees in cities tie up carbon from the atmosphere.

#1 Setting the scene

Old trees are often (but not always) larger in size. Large trees are excellent filters for urban pollutants and fine particulates (very tiny pieces of dust, smoke, bacteria etc.) with their canopies. Older trees regulate water flow with their extended root network and play a key role in preventing floods and reducing the risk of natural disasters. A mature evergreen tree such as a spruce or a cedar, can hold on to more than 15 000 liters of water per year.

Especially large, old trees also feed and shelter birds and small mammals. Many animals use mature trees for nesting, resting and for places from which to hunt. Even dead trees are useful for e.g., woodpeckers that use dead trees to drill for food and to nest in cavities.

Salamanders use rotting logs or stumps as both shelters and food sources. Without big, long-lived trees, these animals could die. Young trees have fewer dead branches and flowers, and less nectar, peeling bark, and woody debris compared with large, established trees, and offer therefore less benefits to numerous species.

It can take more than 200 years for tree hollows to form naturally.

#1 Setting the scene

Though old trees are vitally important to humans and the natural world alike, we keep losing old trees in the cities to make way for urban expansion. Old trees are often seen as a risk as they may lose limbs during heavy winds and cause material damage. When we do not understand the importance of large, old trees, the trees are at risk of being cut down.



Even dead trees are important in the city as they support biodiversity by providing nutrition and homes for e.g. woodpeckers that use dead trees to drill for food and to nest in cavities excavated in *snags* (dead standing trees).

Further reading: [Ecosystem services of a tree](#), [Mature trees in the city](#), and [How trees make our cities livable](#)

#1 Activity

- Every student gets an Urban Tree Bingo Card.
- You will notice that there are three blank squares on the card. In these blank spaces, the teacher can fill in the specifics about trees in your area or you can discuss this with the whole group. Get creative!
- Take your printed Urban Tree Bingo Card with you and place a second version of the Card on the wall, visible for everyone to see.
- Fill out your own Urban Tree Bingo card in your own rhythm. Do this by drawing/taking pictures of the finding, and printing and pasting them on the card.
- Agree on a timeline to fill in the Cards. It is best to choose a timeslot of 2-3 weeks so that all the squares get filled up.
- The first person with a full row, column or diagonal completed, wins.
- Compare the found answers on each other's bingo cards. Discuss the differences.

Find the Urban Tree Bingo Card in the next slide.

#1 Activity

Moss growing on a tree		A tree with more than one colour on its bark	The thinnest tree on your home or school yard (how can you tell?)
	An insect crawling on a tree		A tree with leaves bigger than your palm
A tree that is two persons' wide (you and your friend/sibling/parent join hands around the tree).	A tree with a rough bark	A tree with smooth bark	The number of trees on the yard of your house/apartment/street
The thickest tree on you school or home yard (how can you tell?)	An evergreen tree	A tree with leaves smaller than your palm.	A tree that is three or more friends wide (= you and your friends join hands around the tree).

#1 Reflection



Try to answer the questions below through discussion in group.

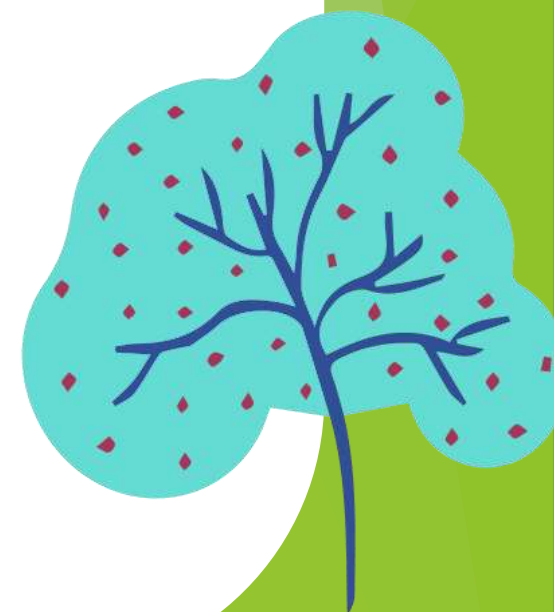
We have learnt that trees offer us many benefits, including taking up carbon from the atmosphere.

- How does this make you feel about trees?
- What is the most beautiful tree you can think of? Where did you see it?
- What can you do to help the trees on your/your school yard live long and healthy lives?

Thinking about your city and the trees there:

- What places in your city are suited to plant some extra trees?
- What trees would you plant?
- Which trees would do well in your city?
- Where could you get help in choosing the types of trees to plant?

(Tip: Which nature/environmental organizations are active in your city? What are the responsibilities of the environmental department of your city?)



#1 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Get to action with the slightly more complicated version of the Urban Tree Bingo.

Two steps

In this version of the Urban Tree Bingo card, each item can be stretched out to its own topic to cover an entire lesson. The background information for the topics should be researched on the internet. The keywords to search for are highlighted on the bingo card.

Find the Urban Tree Bingo Cards for steps One and Two in the next slides.



#1 Take it a step further: one step

Do you want to do more with this lesson? Take it a step further and get to action!

A lichen growing on a tree	A seed of a tree	Share an atleast 10-year-old picture of a (semi-)natural landscape with your classmates. Share also a picture of the same place now. How have the trees in the landscape changed?	The youngest tree on the schoolyard (how can you tell?)
Signs of an animal using the tree for nesting or resting	Damage on a tree	A fruit of a tree	A tree stomp
A tree that is your height or shorter than you	A tree producing the biggest shade in your school yard	Write a poem about/draw a picture of your favorite type of tree (why is it your favorite?)	How many different types of trees are there on your school yard?
The oldest tree on your school yard (how can you tell?)	An broadleaf tree	A tree with leaves smaller than your palm.	Dead tree

#1 Take it a step further: two steps

<ul style="list-style-type: none"> Do a search about mosses on the internet – what are they, what is their function, where do they grow and why. Take a picture of the moss you find. Identify the moss. Optional: look for other ones and get informed about their names and specifics as well. 	<p>Find the mother tree in your yard, a close by park or forest</p> <ul style="list-style-type: none"> How can you tell it is the mother? What happens if the mother tree is cut? 	<p>Find an old picture of your city with trees growing in it. Take/find a picture of the same place now (what happened to the trees?).</p> <p>What other changes occurred in the city between now and when the picture was taken. How much has the green coverage the city changed – more or less green space, more or less trees? Contact your local government to get this information.</p>	<p>The youngest tree on the schoolyard (how can you tell?)</p> <ul style="list-style-type: none"> Read about how trees spread themselves.
<p>Find the Sunniest Spot on your school yard. Draw an outline of the sunny spot-on paper; include in the drawing trees and other shade-producing features. Observe where the sunlight shines on the area at 8:00 a.m.</p> <p>Draw a circle on the paper that depicts the area in sunshine.</p> <p>Repeat this process again at 12 noon and again at 4:00 p.m.</p> <p>Where the 3 circles intersect is the spot that receives the most direct sunlight. This is the most ideal spot to plant a vegetable garden or a light loving tree.</p>	<p>An insect crawling on a tree.</p> <ul style="list-style-type: none"> Identify the insect What is it insect possibly doing on this tree? 	<p>Determine the age and history of a cut tree: Count the dark rings in the tree stomp and you'll know the tree's age! By studying the appearance of the rings, you can gain insight into the living conditions of the tree. The rings might look different in shape, colour, and thickness. For example, narrow rings may tell you that insects have been pestering the tree or the tree has lived through a drought. Wide rings on the other hand may indicate a wet-season or the death of neighbouring vegetation, which allows the tree to grow faster.</p>	<p>A tree with leaves bigger than your palm.</p> <ul style="list-style-type: none"> Why are some tree leaves big, and others small?
<p>The number of trees on the yard of your house/apartment/street.</p> <ul style="list-style-type: none"> Which types of trees are they? Which ones of them are probably the oldest/youngest? Why do you think so? Were they planted here? If so, why do you think they chose for these specific species, i.e., what are their specific benefits? 	<p>A tree producing the biggest shade in your school yard</p>	<p>Write a poem about/draw a picture of your favorite type of tree (why is it your favorite?)</p>	<p>How many different types of trees are there on your school yard?</p>
<p>The oldest tree on your school yard (how can you tell?)</p>	<p>An evergreen tree</p> <ul style="list-style-type: none"> Which tree is it? Is it a native one? How has its leaves adapted to the being evergreen? 	<p>A tree with leaves smaller than your palm.</p> <ul style="list-style-type: none"> Is this a native tree? If not, is it invasive? 	<p>Dead tree</p> <ul style="list-style-type: none"> What do you think caused the tree to die? How will this tree be utilized now?

#1 References and further inspiration

Sources used for this activity:

Picture 1: Stux- pixabay,
<https://pixabay.com/photos/historic-center-city-wall-autumn-197368/>

Picture 2: Clemence Diop, Unsplash
<https://unsplash.com/photos/js-w-Nm0xh8>

Picture 3: Ben Mullins, Unsplash
https://unsplash.com/photos/_iNn_izHCqM

Sources used for this activity:

Natural Habitat
Adventures: <https://www.nathab.com/blog/losing-urban-trees-and-the-wildlife-that-depends-on-them/>

Food and Agriculture Organization of United Nations: <http://www.fao.org/zhc/detail-events/en/c/454543/>

Pinterest: <https://www.pinterest.com/pin/52846995597178488/>

#2 Resistant trees



Description & background:

Students learn about the importance of trees in fighting climate change and building resilient cities. They discover the benefits of trees and the species that are most resistant to climate change in their city.

Fits in subjects:

Biology, geography

Keywords:

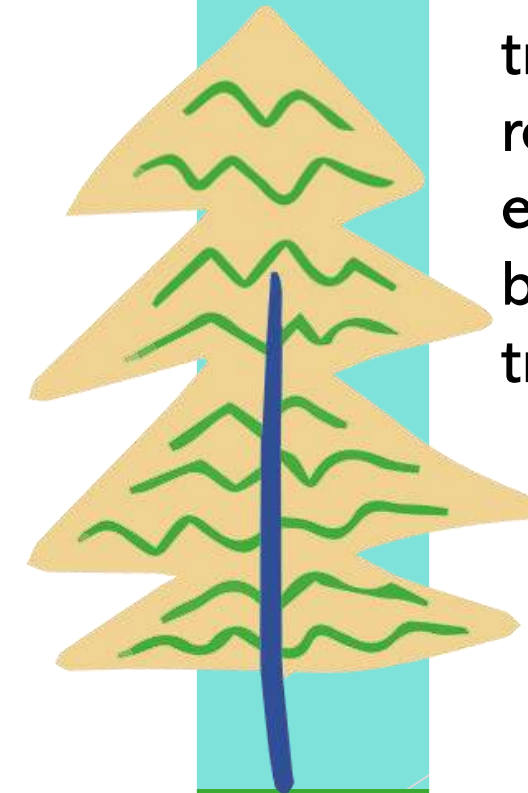
Climate change resistant, urban, resilient, old trees

Goals for student:

Gains knowledge on tree species and develops understanding of the importance of (old) trees in a city.

Suitability:

Outdoors
Summer, spring, autumn



What do you need?

Materials:

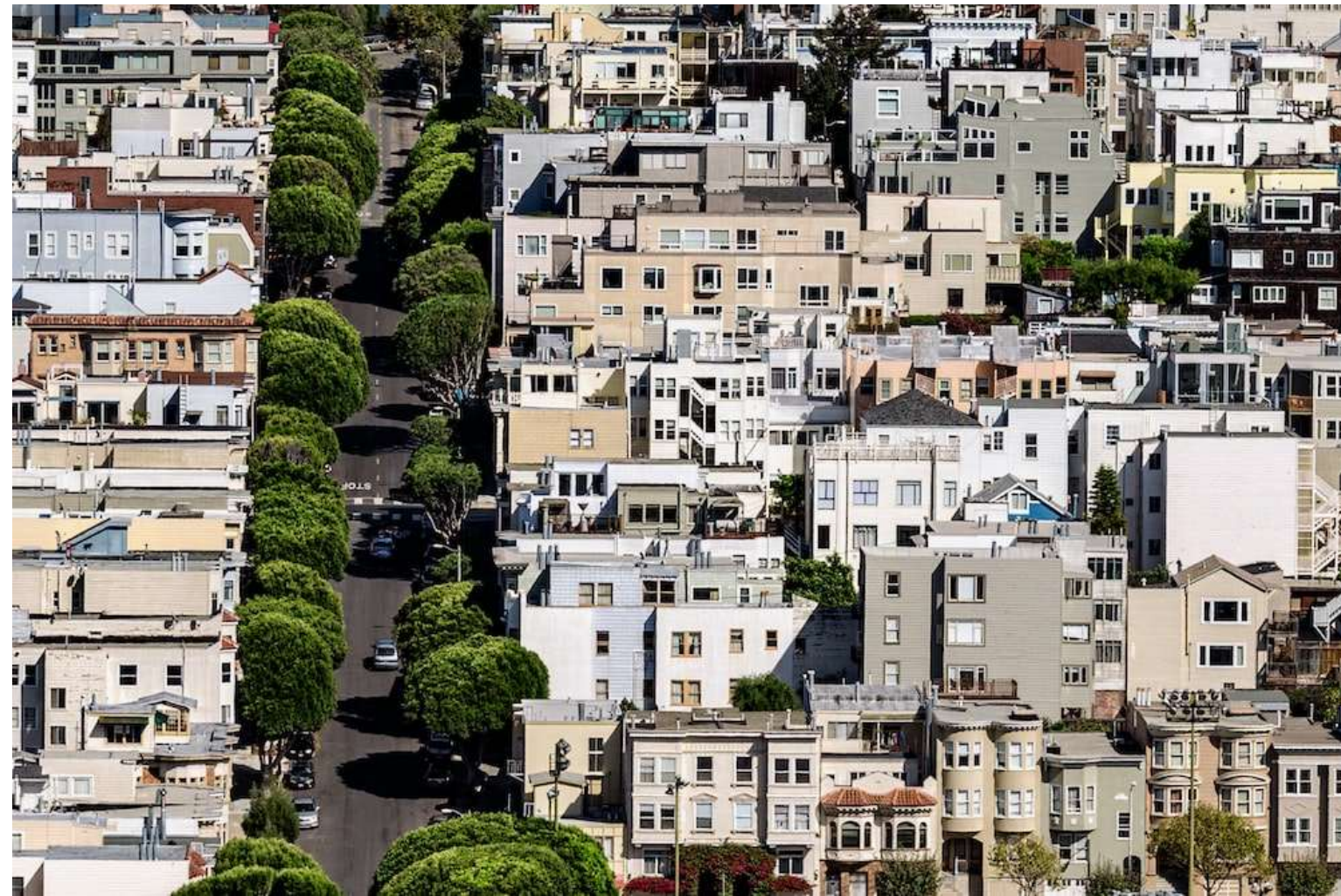
Tree identification chart, pen, paper, list of climate resistant trees for your city/region.

Preparation:

Ask beforehand at a local conservation center for a list of climate resistant trees of your region. Search for a place, e.g., a forest or a park close by with different kinds of trees.

#2 Setting the scene

Trees in a city are extremely important for multiple reasons: they tie up carbon dioxide from the atmosphere, act as carbon sinks (carbon storage) and use photosynthesis to convert the gas into glucose and oxygen. In this process, chlorophyll gives plants their green color. It channels the energy of sunlight into chemical energy: it absorbs energy to transform carbon dioxide and water into carbohydrates and oxygen.



Trees offer shade to the streets and help to cool the city

#2 Setting the scene

Trees are essential in the fight against climate change. Due to climate change, trees around the world are experiencing longer growing seasons, which causes trees to grow faster. However, higher temperatures—combined with pollution from auto exhaust and farms—are making their wood weaker as they take up less CO₂ from the air, resulting in trees that break more easily and making the lumber less durable.



Not all trees are equally resistant to the changing environment. Some won't survive due to droughts, forest fires, etc.

#2 Setting the scene

It is important to plant the 'right' kind of species to fight climate change. Broadleaved species – such as oak, beech and maple – are effective because they have a larger surface area of leaves. This enables more photosynthesis, whereas conifers absorb more heat as they are darker in colour and emit less water into the atmosphere through evapotranspiration.

Planting a diverse mix of species will provide more diverse habitats for more diverse species. Diversity also ensures that the urban forest is better prepared for pests or diseases which could wipe out an entire species of trees in one area, if there is only one species present.

Further reading: [Mature trees in cities](#), [Native and non-native species](#)



Large trees offer shade and companionship in the city.

#2 Activity

- All students are divided into groups of 4-5 and each group gets one or more identification maps.
- Go outside to a place where there are preferably different kinds of trees (big, small, different kinds,...), e.g. a park. Divide the students in groups and let them choose a tree to study.
- Look up the species on the map as a first thing. Draw your tree and come up with a name for it.
- Think about what the tree offers you; does it have fruit, does it provide shade, is it beautiful, is it nice to play in/around it? Write this down in a mindmap.



A tree identification chart is a handy tool that helps you to determine the kind of tree you are investigating. To find charts with trees in your area, contact the local department of environment, nature organisation or use an app such as Plant Snapp.

#2 Activity

- Everyone gathers again and every group presents its answers to the rest of the group. What are the findings?
- Discuss with the whole group: Which trees offer more benefits?
- Every group goes back to 'their' tree and thinks about the following questions.
 - What does this tree need to grow? And more importantly, does it get enough of what it needs? In this step try to think about it yourselves, and only then search for more help online. Write this down in another mindmap
 - Everyone gathers again and every group presents its answers to the rest of the group. Is there one tree that is doing better than the others? Why do you think this is? What would need to change for the others to do as well?



This old oak offers a lot of benefits to its environment.

#2 Climate resistant trees

This list is based on UK conditions. Search on the internet for a similar list for your area or ask your local department of environment.

Trees tolerant of hot, dry conditions

Trees planted for free-draining, south-facing slopes in southern areas are likely to suffer from hot dry summers and prolonged drought in future. The following are suitable;

Small trees:

- **Crataegus crus-galli:** Small spreading deciduous tree to with long thorns.
- **C. x persimilis 'Prunifolia' AGM:** A better garden tree and almost as resilient.
- **Juniperus scopulorum:** A small conical coniferous tree, with reddish bark, and bright blue-green foliage. Almost as robust and better for garden use is J. scopularum 'Skyrocket' whose spectacular narrow form is a welcome addition to many gardens.
- **Gleditsia triacanthos:** The yellow leafed cultivar 'Sunburst' is best for garden use and has the RHS AGM, with bright yellow young leaves ageing to light green by late summer, and is significantly smaller than the green leafed species.

Medium trees:

- **Catalpa speciosa:** Not widely grown but has considerable potential for dry conditions, but has similar foliage and flowers (although sparser) as the common but not particularly drought tolerant *C. bignonioides*.
- **Eucalyptus pauciflora subsp. niphophila AGM:** A particularly hardy evergreen tree noted for its attractive flaking colourful 'snakeskin' bark. However, eucalyptus have been frequently implicated in subsidence and gardeners should be wary of planting near buildings.
- **Ginkgo biloba AGM:** A robust deciduous tree with striking foliage. Female plants produce fruits which can be a nuisance in autumn. Male plants are trouble free.
- **Koelreuteria paniculata AGM:** is grown for its yellow summer flowers followed by bladder like fruits.
- **Pyrus calleryana:** A very robust deciduous tree widely used in landscaping. The cultivar 'Chanticleer' has the RHS Award of Garden Merit with a neat conical habit making it suitable for large gardens.

Large trees:

- **Cedrus atlantica:** A large conifer, conical when young and spreading when taller. The blue leaved form 'Glauca' has the RHS Award of Garden Merit and is especially spectacular as a specimen tree for very large gardens and public open space.
- **Quercus ilex AGM:** A large spreading evergreen with attractive green foliage that is suitable for the largest gardens and parks.

Trees tolerant of waterlogging, i.e. when water is unable to drain away. This leaves no air spaces in the saturated soil, and plant roots literally drown. Not all plants can stand waterlogged or flooded conditions. Special roots are needed for this.

Small trees:

- **Prunus padus:** A small deciduous tree with striking flowers and young foliage and shoots. The cultivar 'Colorata' has the RHS Award of Garden Merit and especially attractive pink flowers followed by dark fruits.

Medium trees:

- **Alnus glutinosa**
- **Betula pubescens**
- **Salix alba:** A compact medium sized tree that is very tolerant of wet soils. Two cultivars that have the Award of Garden Merit are **S. alba var. vitellina 'Britzensis' (m) AGM** with coral-coloured young stems and **S. alba var. vitellina AGM** with bright yellow shoots.

Large trees:

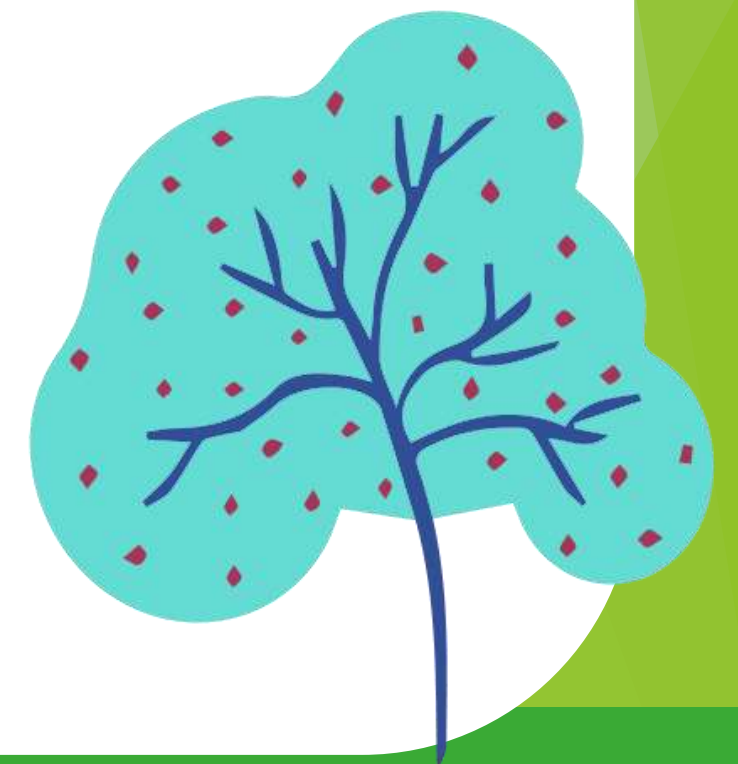
- **Acer rubrum:** A large spreading deciduous tree with remarkable autumn colour. The cultivar is an especially valuable tree for very large gardens and parks:
- **Taxodium distichum AGM:** A large deciduous conifer that is fairly tolerant of drought as well as very tolerant of waterlogging. This tree has an Award of garden Merit but is really suited to very large gardens or public open space.

#2 Reflection



Try to answer the questions below through discussion in group – remember, there might be more right answers than one.

- What would be the smartest; planting a lot of different tree species in one forest, or planting one and the same species? Explain your reasoning.



#2 Take it a step further

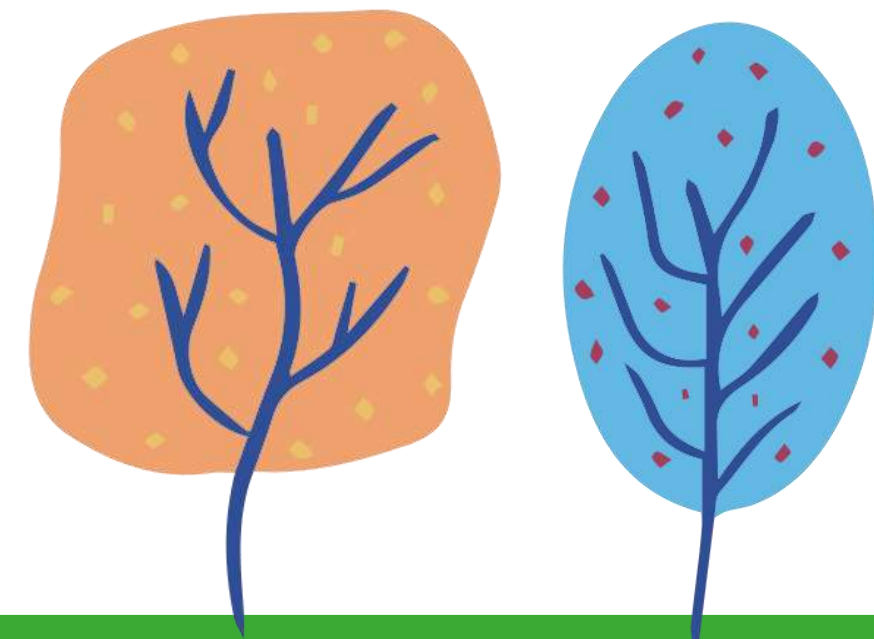
Do you want to do more with this lesson? Take it a step further and get to action!

One step

Compare the findings of your city to another area with a different climate. What kind of trees are most suited for this area?

Two steps

Do a search on climate resistant trees and find out which trees are most suitable for your area. Organize to plant one or some of these trees on your school yard or your home garden.



#2 References and further inspiration

Sources used in this lesson:

Picture 1: Vladimir Kudinov, Unsplash
<https://unsplash.com/photos/T0vd4uCvSH8>

Picture 2: Photo by Felix Mittermeier at pixabay, <https://pixabay.com/nl/photos/beierse-woud-bos-bomenschorskevers-3385966/>

Picture 3: Photo by project Clearing House

Picture 4: Zoekkaart bomen- IVN natuureducatie,
<https://winkel.ivn.nl/bomen-blad-fries.html>

Picture 5: Regalshave- pixabay,
<https://pixabay.com/nl/photos/eik-boom-enorme-oude-charleston-2018822/>

Sources used in this lesson:

Glendale:

<https://www.glendale-services.co.uk/latest-news/plant-the-right-trees-to-combat-climate-change/>

Environmental Activities for Youth Clubs and

Camps: https://files.peacecorps.gov/documents/PC_Environmental_Activities_508_mNd3UVx.pdf

Trees for climate change

(RHS): <https://www.rhs.org.uk/advice/profile?PID=712>

#3 Patterns in nature

Description & background:

These activities illustrate how to use natural resources outdoors. We makes use of sensory perception in a natural environment. The activities invite the students to notice their surroundings with all their senses and introduces them to mindful presence. This type of temporary nature art can teach the youth that not everything of value is material, nor does it have to be taken home, or even returned to at a later stage. Creating short-lived art teaches youth about the impermanence of life, and about the fun of the process of making art.



Keywords:

Fractal, land art, senses, temporary

Goals for student:

Develops creativity; Gains sensory experiences, Builds patience and focus, Builds immunity by bringing youth into contact with natural materials in nature; Teaches about impermanence of life and points out that there are values in experiences not only in material things.

Suitability:

Spring, summer, autumn, winter

Meant for outdoors, but includes an indoors variant



Fits in subjects:

Arts, religion, (basic) math, (art) history, languages

What do you need?

Materials:

All materials you can find in natural environments. Pupils: should wear suitable clothing for safe and comfortable movement.

Preparation:

Teacher should choose and get acquainted with the place (safe and stimulating, enough lose natural materials) and try out the activity to know how much materials are needed. The teacher should collect some items, more for indoor activity.



#3 Setting the scene

Nature is full of numbers and patterns. Mathematicians and poets though centuries have found inspiration and awe in them. You could think of each colour that you see in nature as a number. Light travels as a wave and each colour in the spectrum has a specific wavelength and frequency. For example, Chlorophyll gives plants their green color because it does not absorb the green wavelengths of white light. That light wavelength is reflected from the plant, so it appears green.



The fractal structure of the fern



#3 Setting the scene

One amazing and frequently occurring pattern in nature is called the Fibonacci. The fibonacci sequence starts like this: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 and so on forever. Each number is the sum of the two numbers that come before it. It's a simple pattern, but it appears to be a kind of built-in numbering system of the cosmos. The numbers in the pattern can be found in our own DNA as well the spirals of the Galaxy. The numbers of the Fibonacci sequence are very commonly seen in petals of flowers. Examples include the lily, which has three petals, buttercups, which have five, the chicory's 21, the daisy's 34.



The fibonacci sequence comes back in many natural objects

#3 Setting the scene

Another such pattern is the fractal: A fractal is a detailed pattern that looks similar at any scale and repeats itself over time. A fractal's pattern gets more complex as you observe it at larger scales. This example of a fractal shows simple shapes multiplying over time yet maintaining the same pattern. Examples of fractals in nature are snowflakes, tree branching, lightning, and ferns. Furthermore, it has been found that the fractal pattern is connected to a neural mechanism that affect our brain in a positive way. This can explain why simply viewing nature can be experienced as relaxing and beneficial for our mental capacities.



A snowflake has a fractal structure

#3 Setting the scene

The mandala pattern is used in many religious traditions, such as Hinduism, Buddhism, Jainism or Japanese lifestyle of Shintoism, as a spiritual and/or ritual geometric configuration of symbols that can be used to represent deities, paradises or shrines. Tibetan mandalas are often highly intricate illustrations of religious significance that are used for meditation.

Further reading: [Colours of the forest](#),
[At Dr. Forest's office](#)



A traditional mandala

#3 Activity

In this exercise we want you to dive deeper into the concept of the different patterns in nature. The patterns can be interpreted as a model for the organizational structure of life, a type of cosmic diagram. It is both the microcosm and the macrocosm, and we are all part of its intricate design. You can begin by looking at a certain artist before you leave for the woods (e.g. Andrew Goldsworthy or do a search with the keyword "landart") or read about patterns in nature on the internet with keywords such as "pattern in nature" or "fractal".

- What kind of patterns do you recognize in nature?



#3 Activity

Indoors:

The teacher has a variety of natural resources ready in buckets and baskets if the activity is conducted or look at pictures from the internet.

As the first step, encourage studying the contents with all senses:

"What is this? How does it feel? How does it smell?"

Concentrate on each sense (*visual, olfactory, auditory, tactile*, but think carefully what can be sensed with the *gustatory* sense) at a time and share your experiences after each sense.

What do you think looks interesting and smells strong/surprising, or something that looks or smells pleasant to you but that your classmate does not find as pleasant? Think of more such combinations with the materials you have.

Remember that what you might find unpleasant, might not be unpleasant to your classmate or vice versa. Also, think about what is the function of the scent or visual appearance of the material.

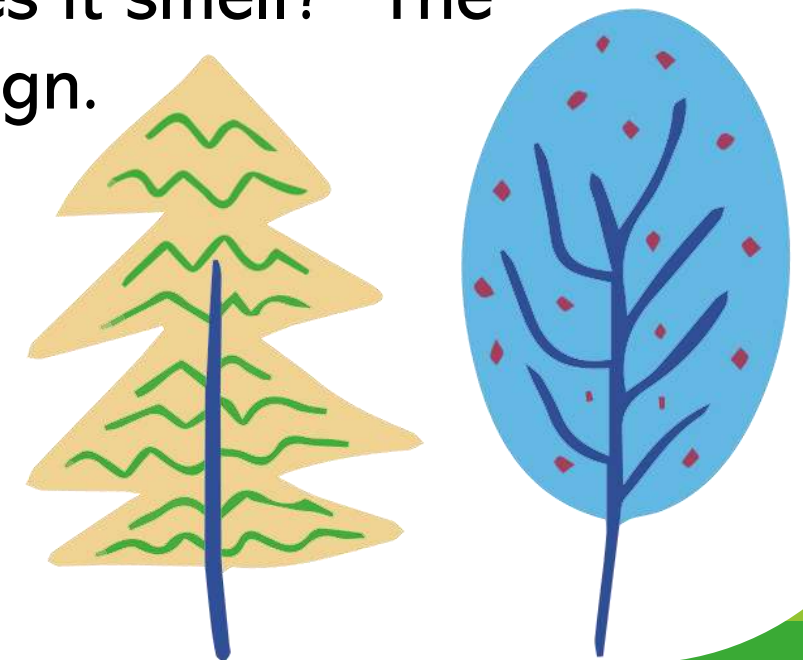


#3 Activity

Outdoors:

1. Go explore with all your senses

- At first, listen to the sounds from the surroundings and separate in natural and human made sounds, as well as in near and far sounds.
- In addition to the already collected items, go explore the surroundings further – collect 5 different objects and compare the feeling of those. Remember to collect only materials that are loose and/or lying on the ground. If you want to pick a growing plant, pick only species that are growing in abundance, and pick only one per species.
- After this, smell the different objects. Look for colors and shapes, for flower petals, blades of grass, pinecones, leaves, pine needles, stones, sticks,... anything else you can find. Look at all this using all your senses; "What is this? How does it feel? How does it smell?" The pupils choose a variety of materials to make pictures of their own design.



#3 Activity

2. Create a mandala with all the material you collected.

Find the center of your mandala and mark it with a special natural object.

Select the first material you'll use to create your first layer.

Build a circular layer around your center item and radiate your design from the inside.

Continue to add on as many layers as you would like!



An example of a 'natural mandala'

#3 Reflection



Try to answer the questions below through discussion in group. Remember that there might not be one right answer.

- Does the artwork need to be dispersed into nature when done?
- What kind of effects can you imagine the artwork having in its surroundings on micro and macro scale?
- Are you aware of the rules for collecting materials in the forest (in your city, in your country?)
- What is the role of e.g., mushrooms, nuts, seeds in the forest for other creatures?
- Should we pick flowers to bring indoors where they will eventually wilt in a vase, what other alternatives might there be?
- What impact is there to the surrounding nature if we remove pinecones, leaves etc.?
- What is the right of the human being to alter the surroundings?



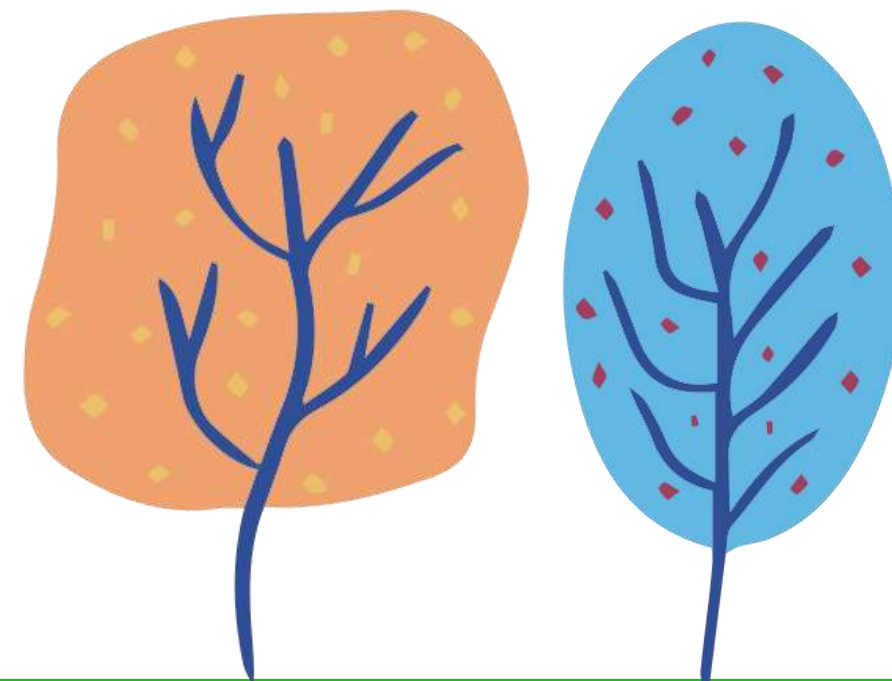
#3 Take it a step further: one step

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Circles in nature: Spot the circles. Count the maximum number of circular objects one can notice in your surrounding nature within a time frame of 5 minutes. If you can, try and measure the circumference and diameter of any circle and divide them to find your own Pi.

Nature Meditation: One pattern in nature is change. Everything in nature is born, maturing and eventually dying. Observe these 3 different stages of life. Find and take pictures of objects in different stages. Reflect on how everything is changing from one stage to another.



#3 Take it a step further: two steps

Do you want to do more with this lesson? Take it a step further and get to action!

Two steps

Geometry in nature: Have you ever marveled at the beauty and shape of a spiral sea-shell?

Geometry is all about shapes and their properties. Lines, curves and shapes that can be drawn on paper make up plane geometry, while 3 dimensional objects are part of solid geometry.

Create a spiral: This can be done individually or in a group. The intention is to create a beautiful spiral with objects found in nature. Make it as big as you can. Each person starts from the same center point and creates one arm of a spiral radiating outwards. After working on it for 10 minutes, the creators stand on the outer edge of their spiral arm and start to walk back one by one to the center slowly following the path of their spiral.



#3 References and further inspiration

Sources used in this lesson:

Picture 1: BkrmadtyaKarki, on Unsplash, <https://pixabay.com/nl/photos/fern-bladeren-groene-natuur-821293/>

Picture 2: Diosming Masendo, on Unsplash, <https://unsplash.com/photos/dWxD-5zhqRA>

Picture 3: Powerpoint

Picture 4: Geralt on pixabay, <https://pixabay.com/nl/illustrations/ijskristal-kristal-sneeuwvlok-kerst-1065155/>

Picture 5: Martina Bulkova, on pixabay, <https://pixabay.com/nl/photos/mandala-kunst-schilderij-acryl-3138969/>

Picture 6: @GKO2014, on Pinterest, <https://nl.pinterest.com/pin/9992430404771194/>

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Sourced used in this lesson:

Sefton Booth Bluebell Park School, United Kingdom, <https://www.bosplus.be/nl/educatieve-projecten/green-learning-environments-eng>

Healing

Forest: <https://healingforest.org/tag/nature-by-numbers/>

Childhood by Nature:

<https://childhoodbynature.com/mandalas-a-practically-perfect-form-of-nature-art/>

The Franklin Institute: <https://www.fi.edu/math-patterns-nature>

#4 It all starts from a seed

Description & background:

You will learn about the different ways in which seeds disperse themselves, what they need in order to start growing, and you will develop an understanding of the interlinkages of things in nature. For this lesson, no prior knowledge of how trees grow is needed

Fits in subjects:

Biology, ethics, sports, geography

Keywords:

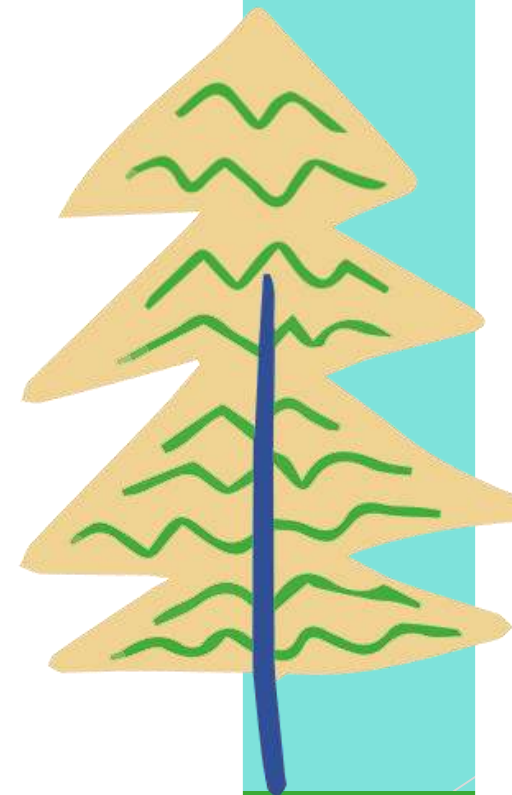
Seeds, embryo, endosperm

Goals for student:

Develops understanding of interlinkages in nature. Builds knowledge on types of seed dispersal activities.

Suitability:

Autumn
Indoor & outdoor



What do you need?

Materials: Bag to collect the seeds along; potting soil, pots for the seeds; paper towels and a dish to germinate seeds in the refrigerator

Preparation: If there are not enough diverse trees on the school yard, the teacher can map out a route which the group can walk together to collect enough materials. Alternatively, the teacher can ask the students to collect seeds from a minimum of 5 different trees within a week's time and bring to school.



#4 Setting the scene

Have you ever wondered why a tree starts growing in the most inhospitable – from a human's point of view – place? Think about a pine tree on a rock cliff or crack of a pavement? Why does it grow there? How did the seed end up exactly there?



#4 Setting the scene

Some seeds, such as acorns, have tough, protective shells. Other seeds, such as maple, have light coverings. A tree seed contains an embryo (baby) tree. This embryo already has tiny leaves, a stem, and a point that will become a root. The embryo is surrounded by endosperm—the food supply for the developing tree. Once the seed falls from the tree to the ground, it is covered by leaves and soil. When the ground is warm enough and other conditions are just right, the seed begins to grow, using the endosperm for food.



The endosperm gives the plant the nutrients it needs to grow roots and to sprout

#4 Setting the scene

When the endosperm is consumed the seed must seek other sources of nutrients through anchoring itself to the ground through a root. It draws water and nutrients from the soil through the root. Eventually a tiny tree emerges from the ground and leaves start appearing. The leaves enable the growing tree to produce its own food through photosynthesis. The shell of the embryo tree then falls off.



Chestnut has spikes on its shell and a thick endosperm.

#4 Setting the scene

Seeds are scattered in different ways. Animals eat seedbearing fruit and then deposit the seeds on the soil in their feces (poop) completely intact. While the seed passes through animal intestines, the coating of the seed gets softened in the bowls of the animal and is ready to start growing when it is out. Wind carries winged and other light seeds while sticky seeds have evolved to cling to an animal's fur (or your sweater!) and ride along to a new location.



#4 Setting the scene

Seeds from most tree species germinate best on bare mineral soil, which has the moisture that they need. Seeds germinating on leaf litter (leaves scattered on the forest floor) often die for lack of water as their roots cannot penetrate the leaf layer to reach the moist soil.

It is important that the seed germinates at the right time. If they sprout too early, they could face cold temperatures and potentially freeze to death. If they wait too long, earlier-sprouting plants can outcompete them, i.e., make it that there is no more space or resources for the seeds to establish.

Further reading: [Native and non-native species](#), [Watercycle in the city](#), [Web of life](#)



Different seeds have different germination times

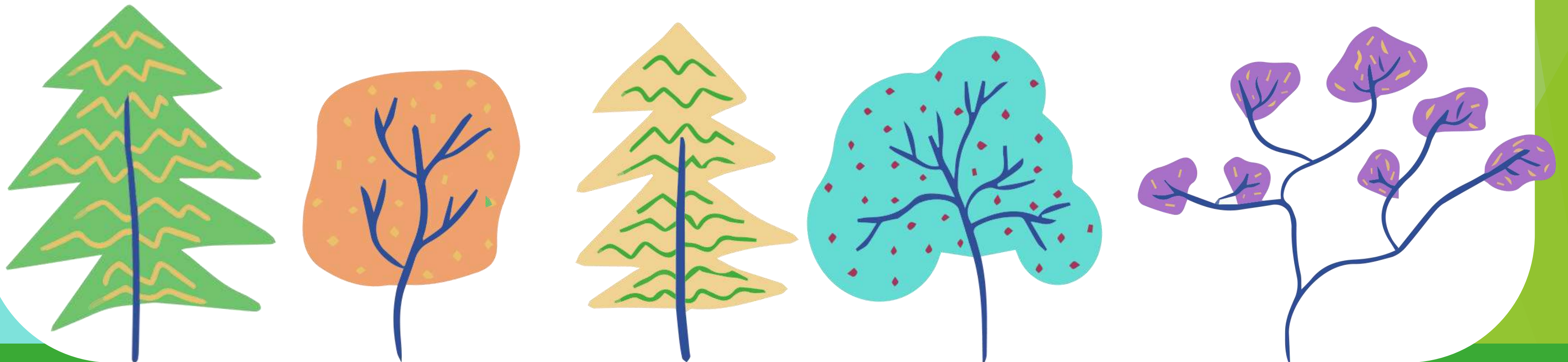


Trees are unique: they sprout according to their own internal clock and lose their leaves according to their internal clock.

#4 Activity

Collect as many kinds of seeds as you can find at school or/and in your neighborhood (one seed per student). Bring the seeds to the class and try to find an answer on as many questions below as possible (in small groups or on your own).

First familiarize with the seeds with your senses: study its form, its colour, its texture (is it hard, soft, bendy, firm..) and its smell.



#4 Activity

- Based on its form, what mechanism does the seed rely on for its dispersal?
- Which plant or tree do they belong to?
- Are the seeds heavy?
- Are the seeds big or small?
- Where did you find these seeds?
- How do you think they got to where you found them?
- Do you think there could be a better place for them?
- Did you see the tree from which the seeds originated?
- How far from the tree was the seed when you found it?
- How did it end up there?
- Which (if any) are seeds that animals might eat? Which animals?
- How does the seed know when it is time to sprout?



#4 Reflection



Try to answer the questions below through discussion in group.

- After this exercise, take the seeds back to where you've found them. It may seem useless to return something so small, but it is not. Why would it matter, you think?
- Have you ever seen a tree growing in an unlikely place? Where was this?
- Why do you think the tree has started growing there? Is it a coincidence?
- Can human beings know where to grow trees?
- Can human beings do as good of a job in making sure that the seed has the best conditions to grow?
- When you eat apples, you are essentially eating that which is supposed to fall on the ground for the tree to be able to grow. Is it okay that you eat the fruit/nut/seed of the tree? Why(not)?



#4 Take it a step further: one step

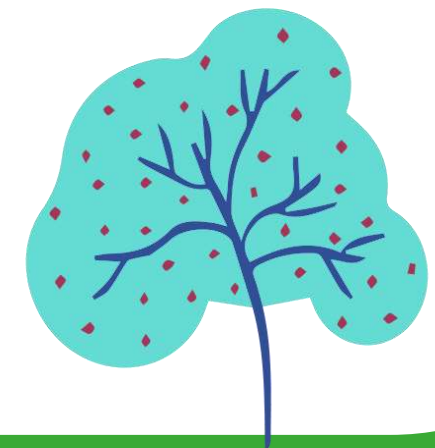
Do you want to do more with this lesson? Take it a step further and get to action!

One step

Germinate the seeds you have collected. The kind of seed you should use depends on the time of the year, autumn or spring. The cue is in when the seeds are ready in nature. Plant the seeds in a pot of regular soil. Cover them with soil and keep the soil moist. Keep track of how many days it takes for the seeds to germinate.

Some seeds, however, will need a cold-pretreatment before they will sprout. A list of examples of seeds needing a cold treatment can be found on the next page.

Place a moist paper towel on a small plate with the seeds on the paper towel and cover them with another moist paper towel. Place the whole thing on a dish in the refrigerator. Keep the paper towel moist and change it about once a week. After 2 months, remove the seeds and plant them in a pot one-fourth of an inch deep containing regular soil. Keep the soil moist.



#4 List of plants needing cold treatment

Many plants require cold treatment, i.e. cold seed stratification, in order to break the dormancy cycle and for them to germinate. The following are some common plants requiring a cold treatment for seeds. Be sure to research the germination needs of your particular plants beforehand:

Butterfly bush

Fuchsia

False sunflower

Hardy hibiscus

Catmint

Evening primrose

Perennial sweet pea

Rudbeckia (black-eyed susan)

Sedum

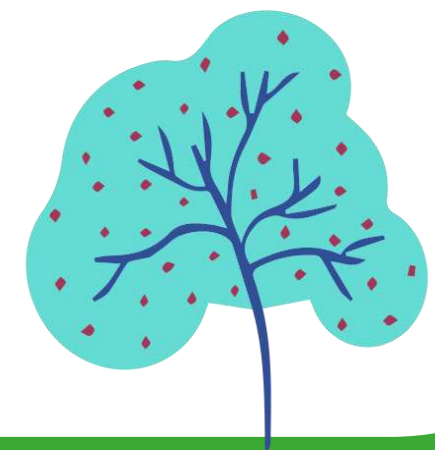
Hen-and-chicks

Ironweed

Chinese lantern

Lavender

Verbena



#4 Take it a step further: two steps

Do you want to do more with this lesson? Take it a step further and get to action!

Two steps

Before planting the seedling, pay attention to the type of conditions where the type of tree likes to grow. Get informed on the amount of water, sun light, and the quality of soil the tree needs. Plant the seed in your (school) yard or the city park where it is safe from lawn mowers and monitor its growth. Depending on the season, you might have to water it in the beginning for some weeks.



#4 References and further inspiration

Sources used for this lesson

Picture 1: Faris Mohammed, Unsplash

<https://unsplash.com/photos/nYGVN45DOHg>

Picture 2: Stephanie Klepacki- unsplash

https://unsplash.com/photos/bPP_TDKChEc

Picture 3: Katie Az- Unsplash-

<https://unsplash.com/photos/v87VhWJOWgU>

Picture 4: Susan Holt Simpson- Unsplash

https://unsplash.com/photos/zHp_umIzhLo

Picture 5: Diana Akhmetianova – Unsplash-

https://unsplash.com/photos/AowZ2Bt_T50

Picture 6: Powerpoint

Sources used for this lesson

<https://www.smithsonianmag.com/smart-news/seeds-use-tiny-brains-decide-when-germinate-180963625/>

Fun science demos: Seeds and the Life Cycle of Plants: <https://youtu.be/KPKM2uc2VNo>

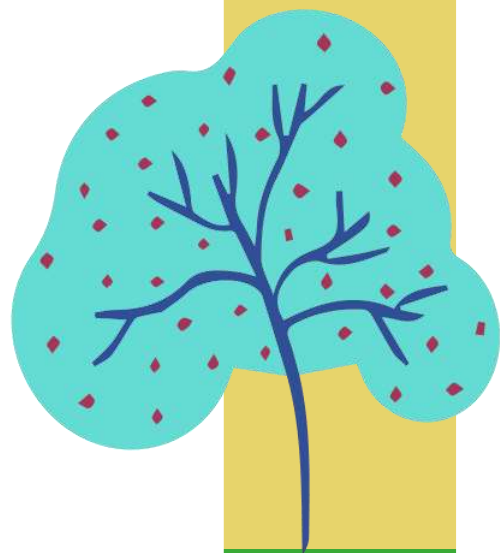
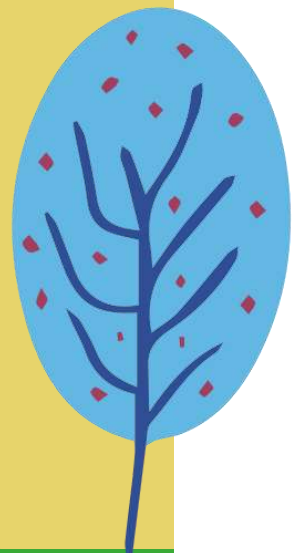
Read more at Gardening Know How: Seed Stratification: What Seeds Require

Cold Treatment <https://www.gardeningknowhow.com/garden-how-to/propagation/seeds/seed-stratification.htm>

#5 Forest models

Description & background

The students will create five different soil structures with the focus on the influence of water on these materials. What are the benefits of more natural material in reference to water? In what way do both trees and water benefit from each other? How can we adapt this to our daily life?



Fits in subjects:

Biology, geography, physics

Keywords:

Water, landscape, water cycle, soil, heat, urban heat island, climate change anxiety

Goals for student:

Develops group work-skills, Builds knowledge on the following concepts: soil, heat, floods

Suitability:

Summer, spring, autumn, winter.

Outdoors or indoors

What do you need?

Materials: 5 different soil components (gravel, sand, clay, potting compost, soil with plants), 5 funnels, 5 jars, cylinder of 50, a balance, water

Preparation: Cover the work area with a water-resistant blanket to avoid a mess. Collect the materials and read the Activity steps.



#5 Setting the scene

The surfaces on our globe are becoming more and more built with buildings and paved with roads and places for parking. Especially in cities, not much space is left unpaved and available for greenery. This causes problems in different areas. The globe is warming, and this has an even bigger impact on paved surfaces.

Stone takes in and holds up a lot of heat. Many urban residents suffer from the city turning into an urban heat island. It means that middle to big cities experience much warmer temperatures than nearby rural areas.



Cities and paved surfaces experience much warmer temperatures than green spaces.

#5 Setting the scene

Next to that, climate change causes periods with a lot of rain next to long, dry periods. Most cities aren't built to deal with this. During periods of heavy rain streets are flooded because the water can't be saved into the soil, stone surfaces can't take in water. This causes dangerous situations. On the other hand, there often is a lack of water for long periods, because the city with paved surfaces can't soak up the water.

Further reading: [Water cycle in the city](#), [How trees make our cities livable](#), [Ecosystem services of a tree](#)



This city is flooded and can't take in the water

#5 Setting the scene

Green surfaces are part of the solution for this problem. Plants and trees hold water for a long period of time. More greenery equals less floods, less heat and less droughts. A city needs paved surfaces to function, but there are a lot opportunities as well to make a city greener and drought and heatproof. It is a good option for streets and parking lots to build them out of water permeable stones.



Façade gardens are beneficial as they are nice to look at, they provide nutrients and nesting and resting places for insects and might help in cooling your home.

#5 Activity

You are divided into 5 groups and every group adds different material in a funnel.

Place the material in a funnel and hang a can under the bottle. This will catch the overflowing water.

Group 1: adds only small stones in the funnel

Group 2: adds sand in the funnel

Group 3: adds clay in the funnel

Group 4: adds potting compost in the funnel

Group 5: adds soil with plants in the funnel



#5 Activity



Group 1: adds only small stones in the funnel

Group 2: adds sand in the funnel

Group 3: adds clay in the funnel

#5 Activity



Group 4: adds potting compost in the funnel



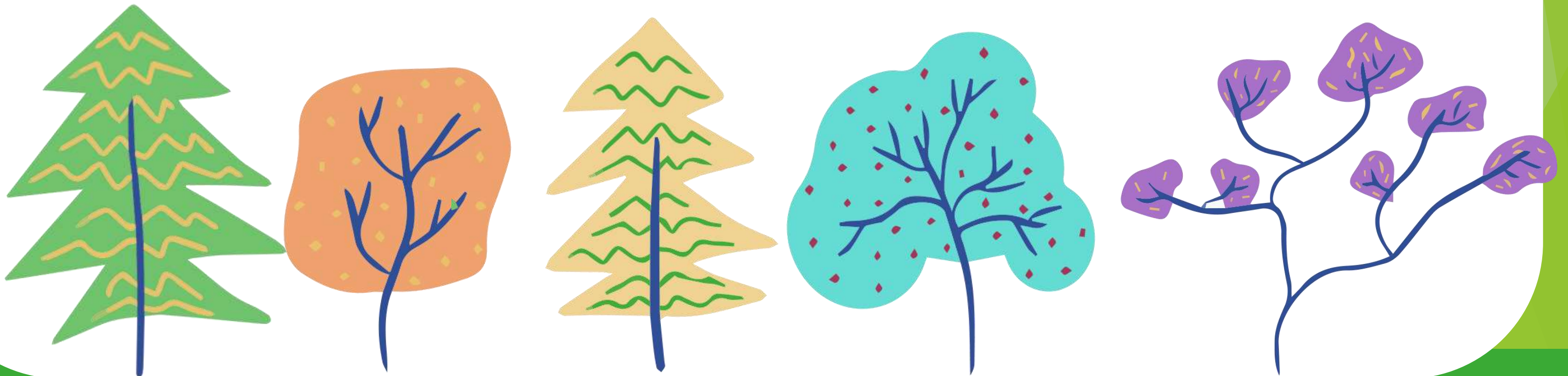
Group 5: adds soil with plants in the funnel

#5 Activity

Each group carefully pours water in their funnel, only 150 ml. Each group measures 1 minute of time from the moment they pour the water in the funnel.

Answer the following questions:

- How much water got through the substance in one minute.
- How does the water look that flows out of it?



#5 Reflection



Try find answers to the questions below through discussion in the group:

- What does it mean that one of the materials holds most water?
- What is the effect of the water flowing away on the other surfaces?

- How are the surfaces of our city/school?
- From a human point of view, where is it good to use materials that allow water to flow through easily?
- Where do humans benefit from materials that do not allow water to flow through?
- How about from (different) animals and plants and trees point of view?

- Have we, here in our city, experienced something like a flood or a drought? If so, what were the consequences? If no, why haven't we experienced such phenomena?



#5 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Take the materials outside, leave them in the sun for half a day and measure the temperature. Organize in order from warm to cold. Compare this outcome to real conditions where the soil consist of this material.

Two steps

Do a search to find out whether your city has experienced a flood (when, what was the damage, were things changed afterward). Talk to people older than you who have experienced floods. How did they manage?

More

Use your feet as thermometers and try standing barefoot on different surfaces on a warm or cold day and see how the temperature changes between grass, cement, asphalt, gravel, mud, wood..



#5 References and further inspiration

Sources used for this lesson:

Picture 1: Wikipedia

https://pl.wikipedia.org/wiki/Rynek_w_Katowicach#/media/Plik:Rynek-WidokNaP%C3%B3%C5%82nocnyWsch%C3%B3d-POL,_Katowice.jpg

Picture 2: Trilemedia, Pixabay

<https://pixabay.com/nl/photos/fietsen-street-overstroming-stad-5680458/>

Picture 3: <https://steenbreek.nl/aanleg-geveltuintjes-in-het-waterkwartier-in-nijmegen/>

Picture 4:

<https://www.pavingexpert.com/permabl1>

Pictures 5-11: Clearing House

Sources used for this lesson:

Fun science demos: Erosion and Soil <https://www.youtube.com/watch?v=im4HVXMG168>

Earthy Perks: How Forests Facilitate The Water Cycle?: <https://www.youtube.com/watch?v=UqqEoEsKzPc>

NASA Climate Kids:

<https://climatekids.nasa.gov/heat-islands/>

Food- and agriculture organisation of the united nations, Soil experiments for children

<http://www.fao.org/3/a-i7957e.pdf>

#6 Forest for rest

Description & background:

This lesson explains the importance of the forest for your wellbeing on a more personal level. The students will dream about their ideal cities and work this out in a creative way.

Fits in subjects:

Arts, philosophical subjects

Keywords:

Stress relief, dreams, city



Goals for student:

Develops a bond with surrounding nature; develops the ability to recognize own moods and feelings, and the impact of nature to their wellbeing. Builds body awareness and feelings of presence. Gains an understanding that in difficult situations in life, nature can help.

Suitability:

Autumn, winter, spring, summer; indoor



What do you need?

Materials:

Paper, drawing and/or painting materials (e.g., pencils, crayons, markers, paint and brushes) or any of your chosen handicraft's materials, like clay, paper mâché; Lego, alternatively a software or a game.

Preparation:

getting materials ready



#6 Setting the scene

If you are feeling nervous, worried or stressed, what helps you to calm down in a situation like that? When thousands of people were asked this, majority of them answered, “spending time in nature”. Research reveals that natural environments - parks, forests, meadows etc. – can reduce our stress levels, stop us from thinking the worrisome thoughts, and make us better able to focus on our homework and any other tasks at hand. In addition, spending time out in nature, makes us feel like we have more energy for the things we like to do.



Nature helps us to find rest and gives energy at the same time

#6 Setting the scene

Why do we feel good in nature? Before we built cities, apartment buildings, had TV's and other comforts, human beings lived very close to nature. You can think of it as birds being able to navigate from Africa to Europe every spring. Because it was once our home, we were attuned to nature and our brain developed to respond to nature.

Even after years of living in cities, our bodies have not changed that much, and our bodies still remember the connection. That is why when we get stressed in a built environment with all the flashing lights, sharp corners and sudden noises, we restore well in a natural environment.

Our bodies relax in nature. It has been shown that when we look at or enter a natural environment, majority of us starts to calm down right away: our heart rate and our blood pressure start to return to a healthier level. The stress hormone called cortisol that is produced in our blood when we are stressed, starts to decrease, and our muscles start to relax.

#6 Setting the scene

After our bodies have calmed down, we can notice that the thoughts no longer race in the same circle, but they have also calmed down. More space and clarity is created in your head. When we have spent time in nature, we tend to be able to focus our attention better. This is true for everyone, but especially for children (and adults) with ADHD will have an increased attention span after spending time in nature. Finally, if we go into nature with an angry mind or sad thoughts, these fade away and we return less angry or sad. This is due to natural landscapes, our movement as well as the natural sounds we hear that also lift our moods.



#6 Setting the scene

There is also an interesting mechanism that has been found to be at work in our brain. The way the tree branches are formed (think of broccoli or cauliflower) they form similar patterns that repeat themselves in different scales from large to small. It is called fractal pattern and our brain enjoys when our eyes view it. In fact, our brain seems to relax when it sees this sort of patterning. This could also be one of the reasons why following the branches of a tree or the waves on the ocean is a relaxing activity. So, it can be said that nature heals as even viewing scenes of nature, can reduce stress, anger and increases pleasant feelings.

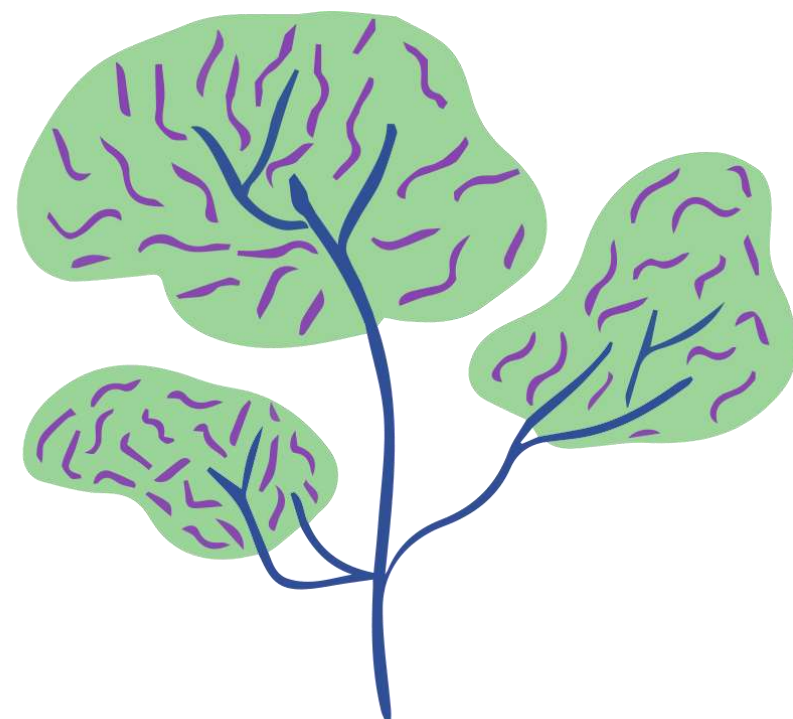
When we do sports in nature, we tend to experience the sports as less effortful and tend to go on longer. All the more reason to run outside than in the gym! Finally, natural surroundings can alleviate pain because they help to distract us from the pain. Many people with chronic (i.e. returning) pain can benefit from a walk in their favorite natural environment. Some dentists even use images of nature as well as nature sounds to distract their patients from pain, discomfort and fear.

Further reading: [At Dr. Forests office](#), [Colours of the forest](#), and Ch 6 on Environmental Anxiety in [Inspirational package for teachers](#)

#6 Activity

You will create your own dream forest, complete with as many trees, animals, mountains, waterfalls, rivers, and even rainbows as you want it. You can draw, build and use whatever material is available.

As you start with the creation of this exercise, the teacher can play an audio of nature sounds to get the students in the mood (many of such ambient music with nature soundtracks can be found on YouTube).



#6 Activity

You can each create an area of earth which is comparable to your living room. Create your natural environment so that it gives you the best possible wellbeing effect. Without adding any man-made elements into it, what makes your space ideal for you? Close your eyes and imagine the sights, sounds and smells in that nature spot. Be creative!

Once you have completed your creations, discuss with your fellow students and teacher, which elements in that nature spot will serve which purpose, e.g., refreshment, calming down, consoling, lifting mood, play.. You will see that there are differences but also surprising similarities.



#6 Reflection



Try to answer the questions below through discussion in group.

Write an individual description of your creation to describe what your dream forest is like.

The following themes and questions will be discussed in group:

- Where do you normally go to when you are stressed/tired/sad/upset?
- Where do you feel safe? What do you need to feel safe?
- Is there a nature spot close to your house where you can go when you feel these feelings? If not, what else makes you feel calm?
- What kinds of nature spots do you think are easy to be found in the city? Which spots are hardest to find?

You can choose to report this information to your local department of environment, or the department of health of your city. If you would rather get more directly involved, you can organize a protest to protect your favorite green space. You can also start a petition for better quality green spaces in your city, circulate it in the school, and hand over to the local government.



#6 Take it a step further: one step

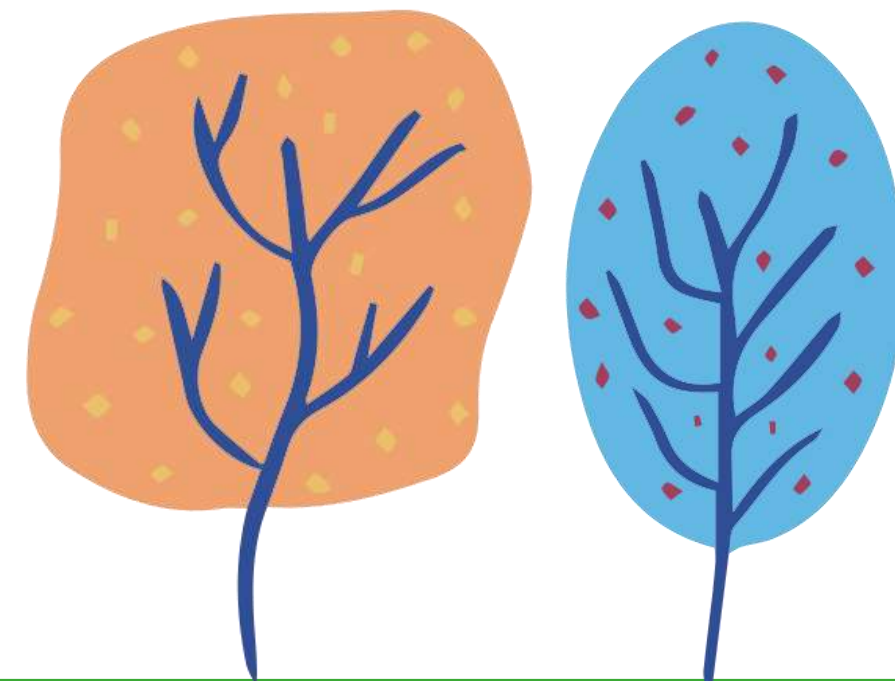
Do you want to do more with this lesson? Take it a step further and get to action!

One step

In your classroom or school yard, create a calm space where you and other students can go to when you are feeling anxious, tired or angry.

Discuss together what things will be needed. Plants? If there are no or only few plants in the classroom, the teacher can ask the students to ask their parents whether they want to bring a cutting or a plant already potted into the school.

How about the soundscape? What activities are possible there – listening to nature sounds? Reading books? Watching pictures?



#6 Take it a step further: two steps

Do you want to do more with this lesson? Take it a step further and get to action!

Two steps

If there is a place on the schoolyard, you can ask your teachers to create a calm spot there for the students to recharge in. This can be as easy as putting a bench next to a tree and dedicating that as the place for resting. To make students more aware of the presence of the trees and its beneficial effects for us, consider placing a board or a nameplate on the tree and titling it "Dr. Forest". You can even list some of the benefits that the students get from visiting with the Dr Forest close to the spot.

More

Create a questionnaire with items on energy levels, tiredness, moods, stress levels etc. Fill in the survey and then go outside into your favorite nature place. After spending a minimum of 30 minutes there, take the survey again. See how your feelings changed. Discuss your results with your classmates.

#6 References and further inspiration

Sources used for this lesson:

Picture 1: Daniel Clay, Unsplash

<https://unsplash.com/photos/DhcrTD25OqU>

Picture 2: Asaf R, Unsplash

<https://unsplash.com/photos/4Ch37gyYAfk>

Picture 3: PowerPoint

Picture 4: PowerPoint

Picture 5:

<https://www.dhresource.com/f2/albu/g4/M00/A/A/71/rBVaEFgS0h6AED7sAACnrApuNi0344.jpg>

Picture 6:

<https://i.pinimg.com/originals/c8/67/fb/c867fb5427fe9b6345df224fb0b3897.jpg>

Sources used for this lesson:

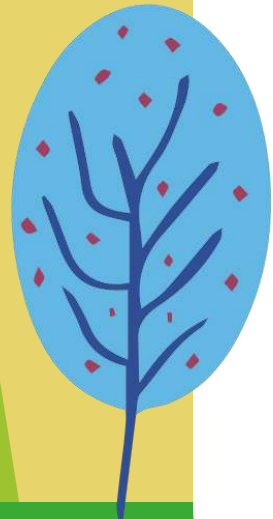
FOREST EUROPE, Liaison Unit Bratislava, 2019:
Human Health and Sustainable Forest Management
by, Marušáková L. and Sallmannshoferet M., et al.
FOREST EUROPE Study.

#7 Web of life



Description & background:

This activity encourages to think about a natural ecosystem. How do the elements in it interact? And how is everything the interconnected in the natural world. It demonstrates the consequences of human actions on the biodiversity of an eco-system. This is a good activity to introduce concepts as biodiversity, resilience, ecosystem.. The ecosystem in question can be that of your own locality (city park, rural forest etc.) or a more exotic ecosystem which is a topic of a lesson.



Keywords:

Biodiversity, habitat, ecosystem, interconnectedness

Goals for student:

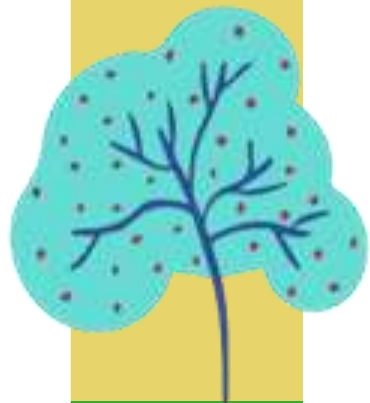
Develops understanding about interconnectedness of everything in the natural world; impact of human actions to nature concepts: web of life, food chain, eco-system, biodiversity, ecosystem diversity

Suitability:

Spring, summer, autumn, winter- indoors or outdoors

Fits in subjects:

Natural sciences, maths



What do you need?

Materials:

- One ball of string or wool (at least 20)
- Approximately 15 labels, each with the name of an organism or element in an eco-system of your choice.

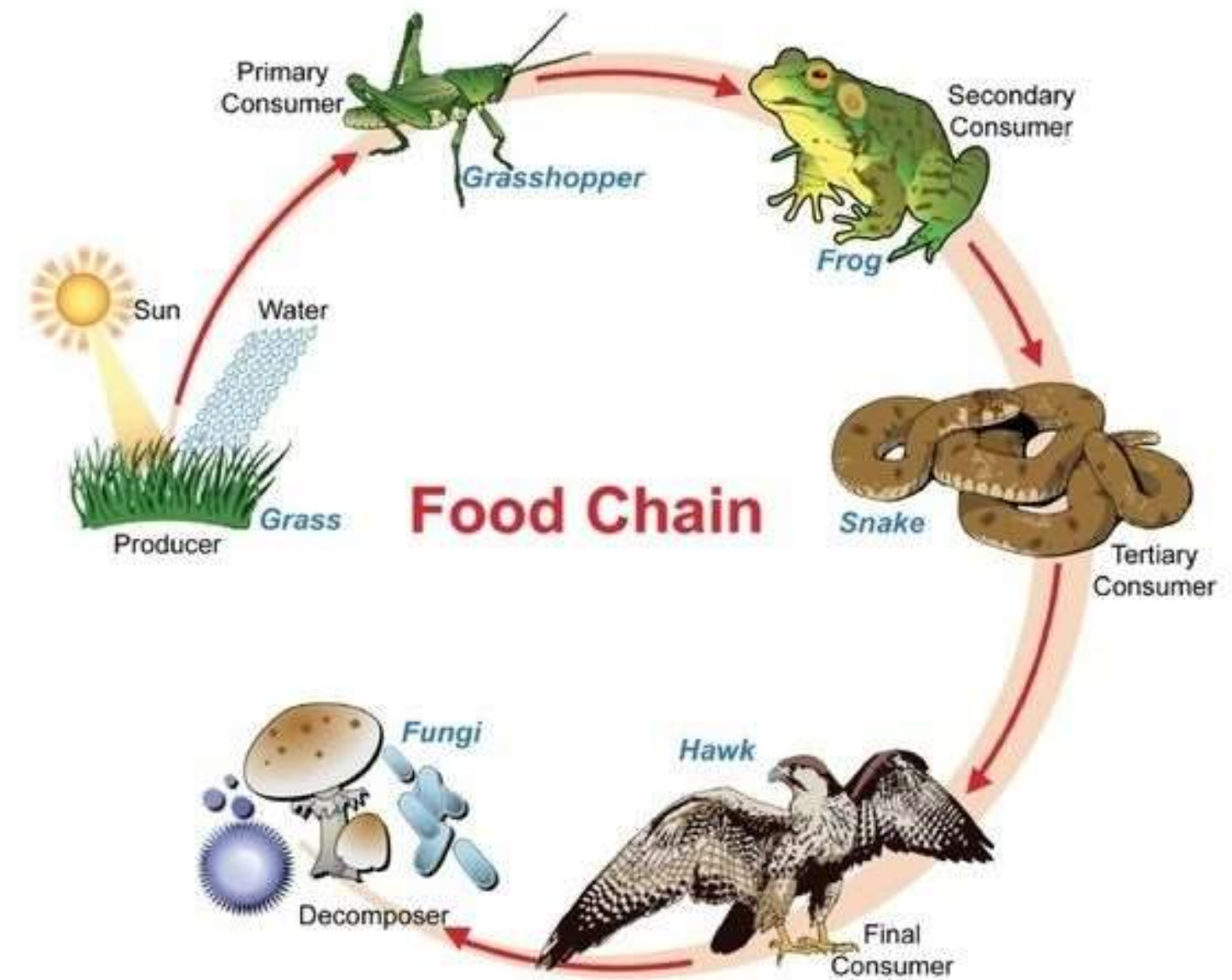
Preparation:

Make labels to attach to the web. Here is an example list from a woodland river ecosystem: *rain, river, oak tree, soil, fish, frog, heron, otter, spider, fly, beetle, bat, bluebell, bee, squirrel.* Add or leave out labels according to the amount of students

#7 Setting the scene

An (urban) forest is a complex living system and it comprises of many more organisms such as plants and animals that interact with and depend on each other than only trees. A tree is living in a dynamic symbiosis with the fungus network in its roots. The tree is providing nesting area for birds such as the jay who, in return helps spreading the oak nuts to other areas in the forest, thus helping the tree to spread its coverage and establishing at the end of the forest.

A **food chain** is a simplified way of showing the relationships between plants and animals in an ecosystem. For example, a food chain of sun, plant seed, mouse, owl shows that a plant seed that grows from the sun's energy is eaten by a mouse, which in turn is eaten by an owl. However, most animals do eat more than one type of does, especially if the food is hard to come by at times. A food web depicts the interaction of many food chains in an ecosystem.



#7 Setting the scene



These are all particular parts of the foodchain. Also the dead tree below is an optimal ground for fungus to grow. In this picture you see two different fungi, one lighter, one darker.

Further reading: [Web of life](#), [Native and non-native species](#)

#7 Activity

- Everyone receives a label with an element (a plant, insect, animal...) of the chain to stick on the front of their jumper.
- Each group is given a large ball of string/wool.
- One student (e.g., the squirrel) holds the end of the string, then hands the ball to another student (e.g. the oak tree), while making a statement about the relationship between the two things on the stickers (e.g., the squirrel eats acorns from the oak tree).
- Now, the "squirrel" is holding the end of the string, and the "oak-tree" is holding the ball.
- Next, the oak-tree passes the ball to a third student, again making a statement, but holding on to the string (e.g., the oak tree needs water from the rain in order to grow).

#7 Activity

- Now two students are holding onto the string at different places and the third is holding the ball. The activity continues like this, with the ball being passed back and forth, but each student holding onto the string.
- Every time the string is passed the student passing it must make a statement. Some elements, such as the river and the rain in the above example, will have multiple connections to other elements. In this case, a student may be holding the string in 3 or 4 different places. Soon a web of string will have been created. You can demonstrate how strong the web is by pushing the middle of it gently. To demonstrate how the web can be disrupted, you can remove one of the key elements from the web.

#7 Reflection



Try to answer the questions below through discussion in group

- Think about what plants and animals you might find in a healthy forest ecosystem? What might happen to the forest ecosystem if we remove an item from this list? What might happen if humans are introduced to this ecosystem?
- Imagine that the river has been polluted; the oak tree has been cut down. Then the child with that sticker lets go of all the bits of string he or she is holding. The web is no longer resilient, but weak and the threads are loose. You can also ask the students to make statements about the consequences of these elements being removed (e.g. without the river, the frogs will disappear from the forest, without the oak trees, there will be no leaf-litter so the soil will not be as rich and the bluebells won't grow etc.) so more and more of the elements are disconnected from each other and the web is weaker and weaker. Reflect on how human behavior affects the web of life. How does that make one feel? Which emoji would you use?



#7 Take it a step further: one step

Do you want to do more with this lesson? Take it a step further and get to action!

One step

First, take a walk outdoors in your school yard or local community to record some of the species living there and then create the web of life. Create more webs-of-life at a time and record the links on paper. Compare the different ecosystems to each other to really clarify the idea of biodiversity. Which one is more diverse?

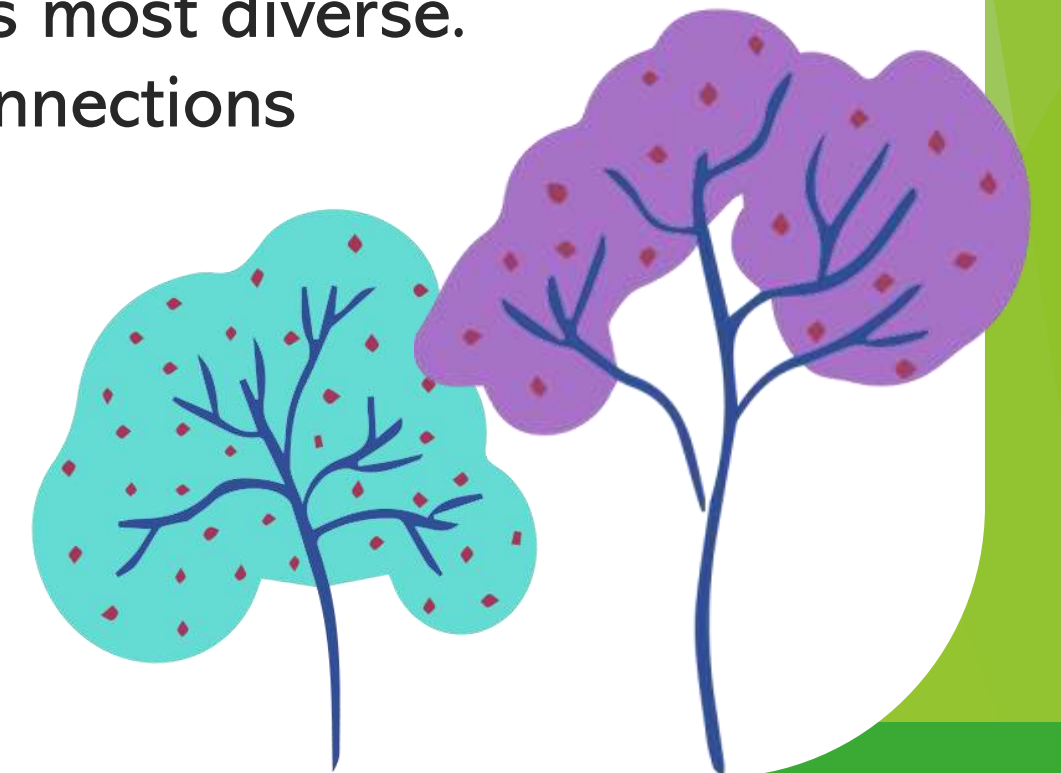


#7 Take it a step further: two steps

Do you want to do more with this lesson? Take it a step further and get to action!

Two steps

Create more webs-of-life at a time and compare these to each other to really clarify the idea of biodiversity and resilience. Do the activity with the students and the ball of wool and record the connections on a paper. Do the tests with cutting down some of the connections as a result of pollution, urban development, alien species, and see what it takes to collapse the entire ecosystem. Do the same again with another ecosystem with different labels, record it again and test again the web's resilience. Compare then these different ecosystem with each other (e.g. diverse deciduous forest versus monoculture forest; swamp versus city park) and see which one is most diverse. Which one is more resilient? What else is there to learn from the interconnections between species?



#7 References and further inspiration

Sources used for this lesson:

Picture 1. <https://i.pinimg.com/736x/65/ea/b1/65eab1220d21b8f7cceed677f5bc9b24.jpg>

Picture 2. Keith Luke- Unsplash,

<https://unsplash.com/photos/-FrVt6GrCvw>

Picture 3. Photo by Geoff Park on Unsplash

https://unsplash.com/photos/ywz_3Qc0xdw

Picture 4. Chris- Unsplash;

<https://unsplash.com/photos/pxiXOtJam9A>

Lesson inspired by

Green Schools, An Taisce the National Trust of Ireland. <https://www.ecoschools.global/>

Similar activities (26. Ecosystem Web):

https://files.peacecorps.gov/documents/PC_Environmental_Activities_508_mNd3UVx.pdf

#8 The air we breathe



Description & background:

This is a citizen science exercise about trees and how they contribute to better air quality through photosynthesis and capturing fine dust. Students will go out in the city to measure the amount of fine dust at several places with a simple self-created fine dust-sensor. This measurement will tell about an environment and its air pollution. Which factors make an environment polluted and how can you mitigate this?

Fits in subjects:

Technology, geography, physics, health

Keywords:

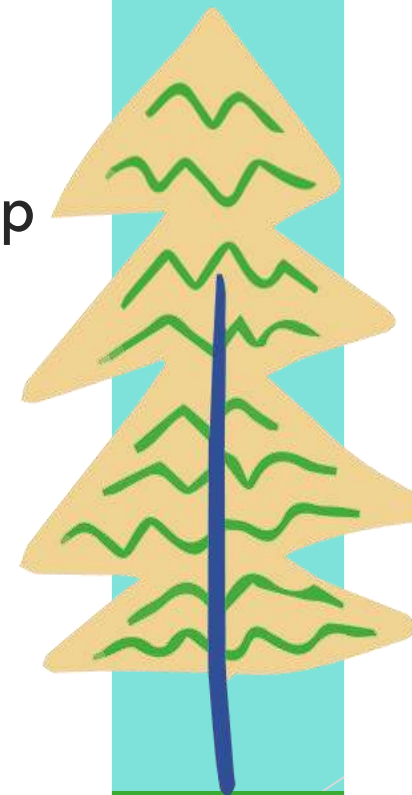
finedust, air, pollution, urban, citizen science, photosynthesis, health effects

Goals for student:

Develops groupworking skills, Gains an understanding on concepts such as photosynthesis, finedust

Suitability:

Autumn, winter, spring, summer
Indoors & outdoors



What do you need?

Materials:

- Picture that explains fotosynthesis,
- graph paper (x3),
- scissors,
- solid backing for graph paper (for example: cardboard, plywood),
- petroleum jelly,
- plastic knife
- binder clips
- magnifying glass,
- microscope
- paper
- pens

Preparation: /

#8 Setting the scene

One of the easiest ways to understand the value of trees in the city is imagining how they influence the air quality. In order to live, the trees consume carbon dioxide that is plentiful in the city air, and replenish it with fresh oxygen, which they produce through photosynthesis, in which carbon dioxide is transformed into oxygen and hydrogen. Carbon dioxide is a gas that warms up the air.



When there is a lot of finedust in the air, it seems the city is covered in fog. This phenomenon is called smog.



Climbing plants and trees filter finedust out of the air.

#8 Setting the scene

Another wonderful thing trees do is filter fine dust out of the air. Fine dust is invisible and consists of small particles in the air. You can't usually see them, but we breathe them into our airways where they cause problems for our health. Fine dust is mainly present in cities as it is produced by cars, factories,... where it does not warm the earth like carbon dioxide but is especially unhealthy. Sometimes you can see it, this phenomenon is called smog.

Large trees are excellent filters for urban pollutants and fine dust. The trees absorb pollutant gases (such as carbon monoxide, nitrogen oxides, ozone and sulfur oxides) and filter fine particulates such as dust, dirt or smoke out of the air by trapping them on leaves and bark. Do you need more proof of old trees importance?

#8 Setting the scene

Air pollution increases the chance on cardiovascular disease, strokes and certain forms of cancer. It can also cause or worsen asthma and chronic bronchitis. Air pollution causes many premature deaths a year and is called the invisible killer. However, when the fine particle content in the air is especially heavy, it seems as if there is a layer of fog hanging over a city. This fog is called smog and it is most unhealthy to breathe in and most visible too. It is important not to do any sports on a day of smog as this could cause irrevocable damage to your lungs. Similarly, it is important that air can move in the city, otherwise dirty air gets trapped into an area causing health problems.

Further reading: [Air quality in a green city, At Dr. Forest's office](#)



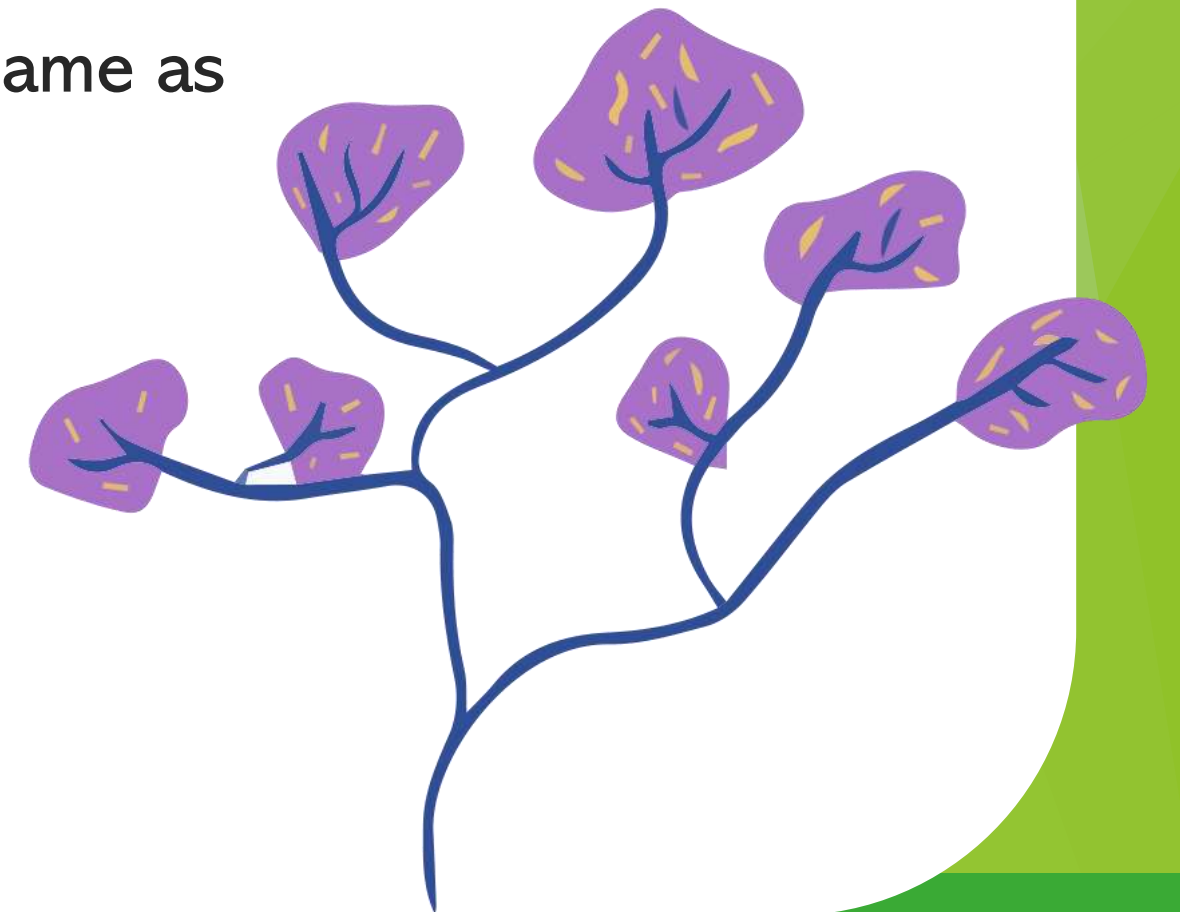
Smoggy sunset creates breathtaking colours.

#8 Activity

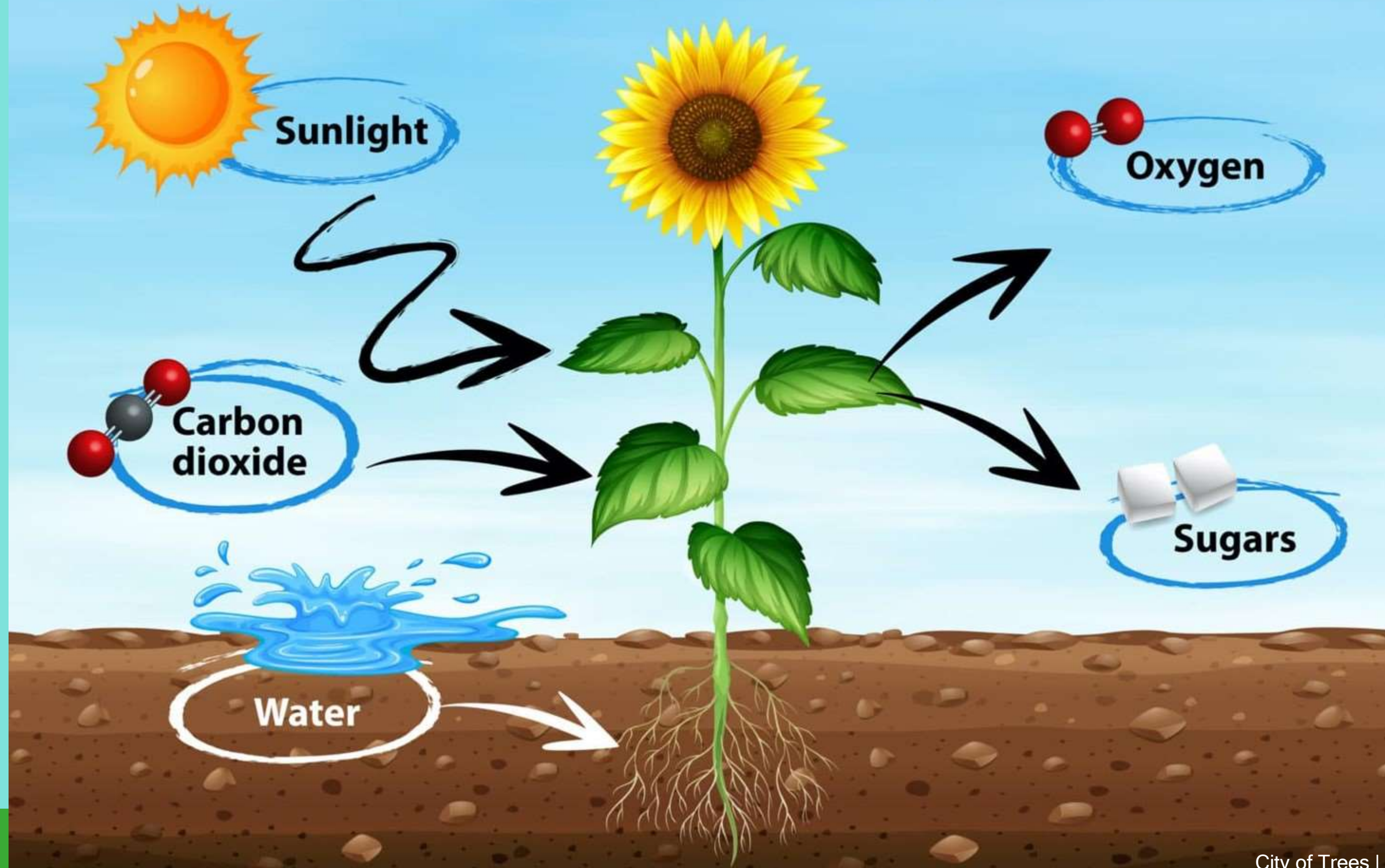
Below there's a picture that explains how photosynthesis works (see large on next page). Watch and discuss this in group.

- Discuss photosynthesis in group
- Think of places with a lot of 'oxygen', where it is nice to breathe.
- Is the classroom a place like that? Most classrooms are not places with the cleanest air. What are ways to make the classroom a nicer place to breathe?

Further in the exercise we will focus on fine dust, which is not the same as carbon dioxide.



Process of Photosynthesis

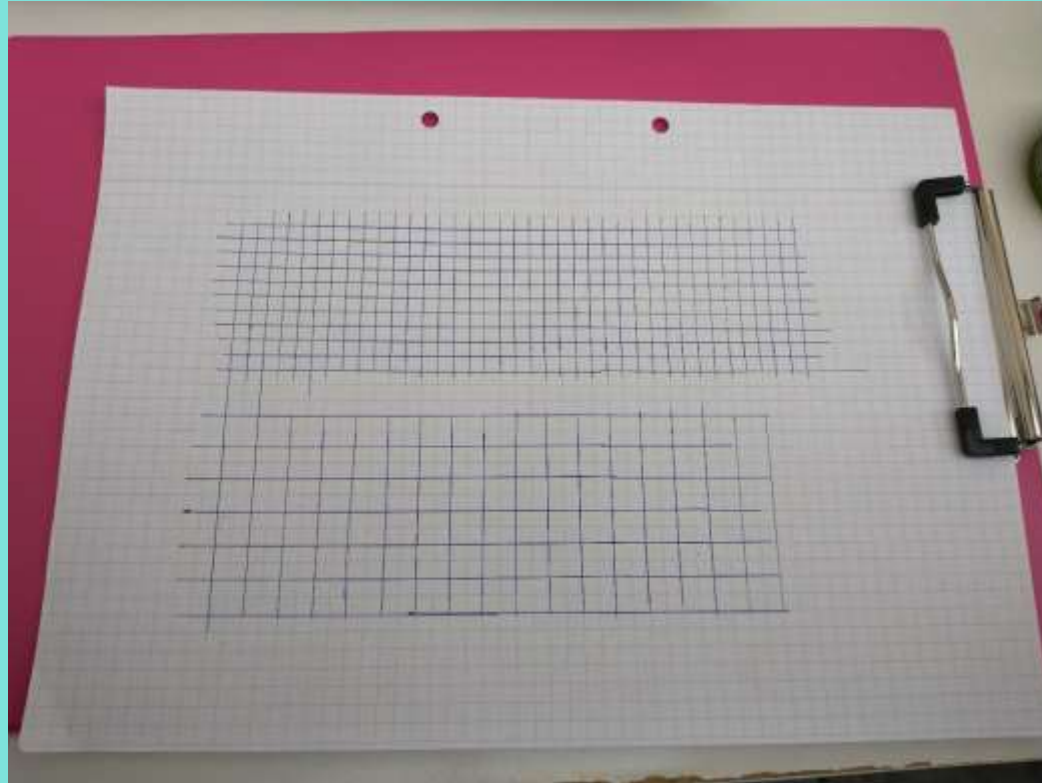


#8 Activity

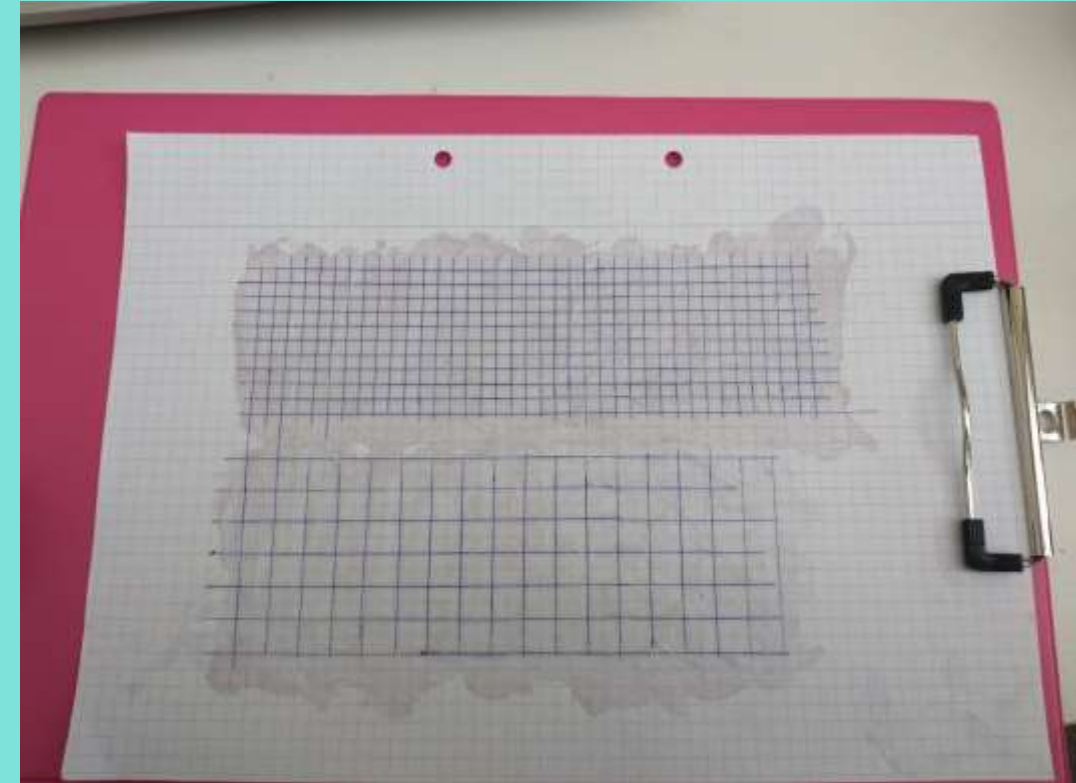
In a group of 4-5 students, you will make your own air pollution measure-system.

- Cut the graph paper and adjust it to the cardboard, making sure the graphs are not covered
 - Cover all the graphs in petroleum jelly, be sure the layer of jelly is thick enough; the thicker the layer, the easier it catches pollutants.
 - Decide where the different cardboards will be put. Look at the map of the city together. Search for places with a different environment (a big park, a large road with a lot of traffic, a place in the city centre with less traffic,...). You can also hang some boards indoors.
 - Go out and place the boards horizontally, make sure to attach them well outdoors in the busy locations. Place a note next to the cardboards that this is an experiment, so that those passing by won't take the board away.
 - Go back to the boards 24 hours later and bring them back to the class.
- Time to analyse! Each group counts the caught particulates. Use the microscope. Count the number of particulates in each square of the graph paper and record them in a table laid out with the same number of squares as the graph paper.

#8 Activity



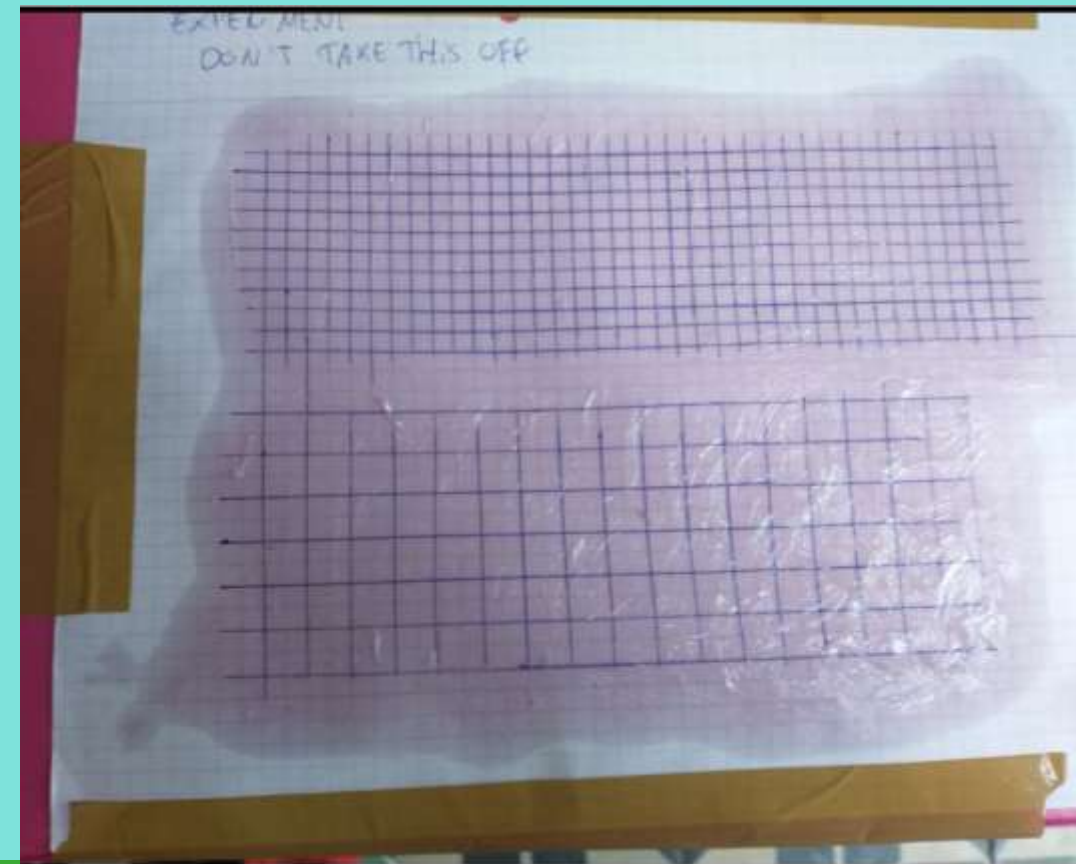
Step 1:
Adjust the
graph paper
on the
cardboard



Step 2:
Cover the graphs
with petroleum jelly
(vaseline)



Step 3:
Hang the
board at a
certain
place



Step 4: Take
the board off
after 24 hours
and count the
little black
particles in
each square

#8 Reflection



Go over the table and talk about the differences.

- Which areas were the most polluted?
- Which other things might have affected the result?
- How can you protect yourself from too much exposure to air pollution?



#8 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Go measure further in the city, closer to places where the students live in and indicate these places on a map. Do this for a longer time and see what changes over time. What is the effect of weekends, different seasons?

Two steps

Take the measuring of fine dust a step further and build a finedust- sensor. This is an ideal lesson to incorporate to subjects that teach about technology.

You learn everything on how to do this on this site: <https://sensor.community/en/>

More steps

Do you have plants in your classroom? Maybe you can take some from home (a cutting from a plant you have at home) to make it a healthier and more comfortable place.

Don't forget to ensure the plants are taken care of in the classroom, even during holidays.



#8 Take it a step further

References and further inspiration

Sources used for this lesson:

Picture 1: Nick van den Berg on Unsplash,
<https://unsplash.com/photos/2vb-3t6YCM>

Picture 2: Pelayo Arbués- Unsplash,
https://www.files.ly/photos/LLklx_IVDfo

Picture 3: <https://www.ck12.org/c/earth-science/effects-of-air-pollution-on-the-environment/rwa/Smoggy-Sunsets/>

Picture 4: <https://www.science-sparks.com/wp-content/uploads/2020/04/Photosynthesis-Diagram-1024x759.jpg>

Picture 5-8: Clearing House

Sources used for this lesson:

Bruzz.be: <https://www.bruzz.be/milieu/zelf-fijnstof-meten-beter-weten-2018-08-22>

InfluencAir. Citizens measuring air quality in Brussels: <https://influencair.be/>;

Sensor Community:

<https://deutschland.maps.sensor.community/#6/51.165/10.455>

Instructables:

<https://www.instructables.com/id/Air-Quality-Classroom-Experiment/>

#9 Food forest

Description & background:

This lesson is about the different ways forests can also produce food for people. The different layers of the forest structure will be introduced, as well as the different functions of the food forest and the concept of organic farming will also be introduced.

Fits in subjects:

Arts, biology, maths, societal topics

Keywords:

Food forest, biodiversity, food security, understory, overstory, herbaceous layer, root layer, shrub layer, ground cover layer, vine layer, pesticide, fertilizer, herbicide, organic



Goals for student:

Learning where some foods come from, learning to value the different products forest produces. Understanding where different forest products grow and what the benefit of a food forest is.

Students will learn about the differences between monoculture forest and diverse food forest

Suitability:

Spring, summer, autumn, winter- indoors & outdoors



What do you need?

Materials:

Recycled/scrap paper and markers to write the names of the plants on them for students to hold.

Alternatively, you could draw pictures of the different species for students to hold.

Preparation:

Teacher needs to familiarize where each species should be best placed.



#9 Setting the scene

What is a food forest?

A food forest, or a forest garden, mimics the ecosystems and patterns found in nature in a diverse planting. Unlike in a monoculture where a field consists of only one crop, e.g., corn or oats, in food forests, several different plants, shrubs and trees grow in different layers, all producing crops for human consumption. This is more ecological, as a diverse planting is more resilient against pests, does not need pesticides (poisons against little bugs eating the crops), herbicides (poison against weeds) or external nutrients in the form of fertilizers, and it is more favorable to the nature surrounding the forest. Due to no use of synthetic pesticides, herbicides or fertilizers, food forest produces organic produce.



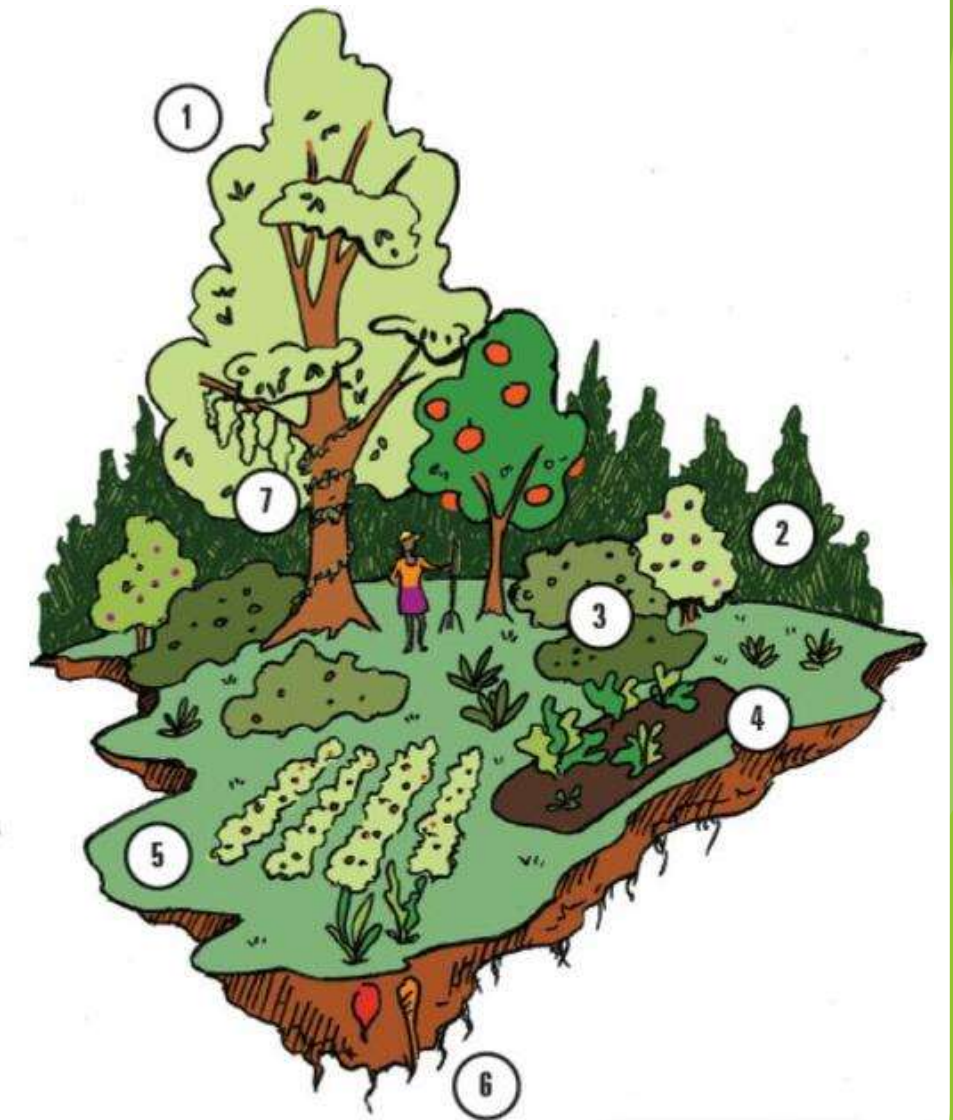
#9 Setting the scene

Food forests are mostly three-dimensional designs with life extending in all directions – up, down, and out. Generally, we recognize seven layers of a forest garden – the overstory, the understory or low tree layer, the shrub layer, the herbaceous layer, the ground cover or soil surface layer, the root layer, and the vine layer. Using these layers, we can fit more plants in an area without causing failure due to competition.

A food forest does not have to be re-planted year after year. Once it is established, the plants reproduce their crops annually. Also, a food forest is quite resistant against, e.g., deer and rabbits who will favor some plants while leaving others alone. Because perennials have healthy underground systems, they will be able to bounce back, even if they were destroyed by grazing animals or playing children. Trees, shrubs, and vines mostly go undamaged.

LAYERS OF A FOOD FOREST

- 1. Canopy**
Large Fruit & Nut Trees
- 2. Low Tree Layer**
Dwarf Fruit Trees
- 3. Shrub Layer**
Berry Bushes & useful Shrubs
- 4. Herbaceous**
Flowers, Herbs & Vegetables
- 5. Soil Surface**
Low-Growing Ground Covers
- 6. Root Layer**
Fungi and Root Vegetables
- 7. Vertical Layer**
Vines & Espaliers



#9 Activity

Anyone can adapt this to their particular food forest or region.

1. Each student is designated a plant name.

2. Different types of plants, e.g. trees, are asked to step forward first and we talk about spacing them and where they should be placed. Consider the needs for sun, space between individual trees (generally it can be said that a tree's roots are as wide under the ground as their canopy is above), height of a tree and how it will shade the others.

3. Students take their places and extend their branches (their arms). Students that are shrubs or bushes either squat or sit on the floor. Students that are ground cover species can decide whether they would like to sit or lay on the floor. If it is difficult for any student to participate by sitting, laying, squatting, stretching arms out, etc. there is also a sheet for the important role of being the sign placed in the food forest to let others know how to utilize the space and there are pollinators (can also discuss which pollinators are attracted to which plants).

4. After all the students are in their food forest placement, we discuss what it looks like, the different layers, who might have difficulty gathering sunlight, who grows well in the shade, etc.

#9 Reflection

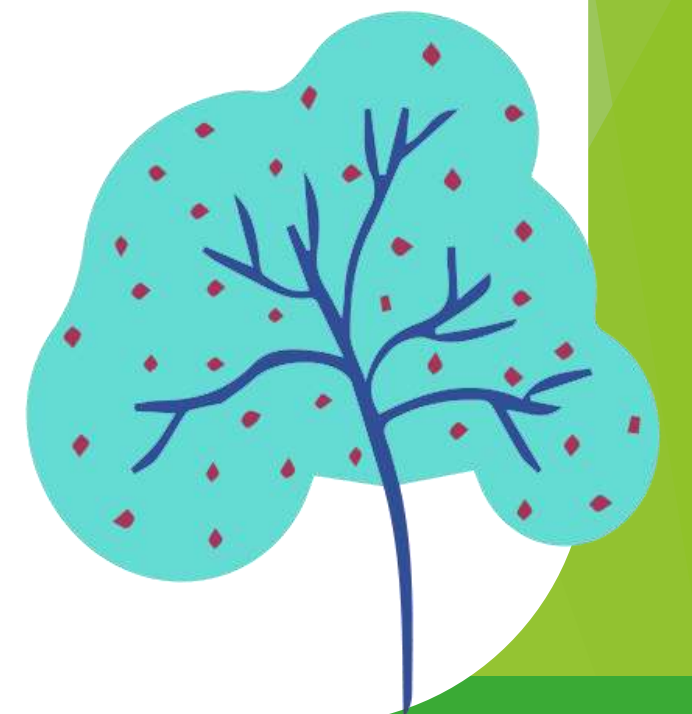


Discuss the following in a group:

What effects would it have if your city or town had a food forest in it (e.g. a new forest or turning an existing forest into a food forest).

- favorable consequences (for nature, people, ...)
- harmful consequences (for nature, people, ...)

Who has the right to the harvest of the products of a food forest located on public lands?



#9 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

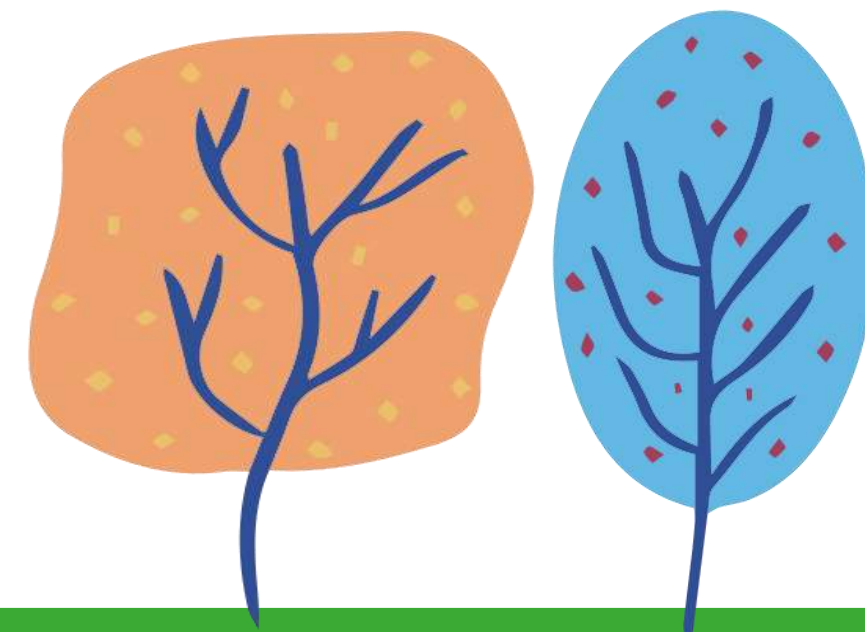
Vary with movement and muscle toning in the set-up. e.g; the students in the ground cover plants plank, the shrubs squat, the trees do arm rotations..,

Two steps

Learn about different climatic conditions than your own environment. How would a food forest in the tropic or boreal region look like?

More steps

Think about the actual steps of planting a real food forest, what is the ground structure, when should you plant... And ultimately, plant the food forest!



#9 References and further inspiration

Sources used for this lesson;

Picture 1: <https://stickingupforlife.com/food-forest-our-zone-9b-edible-landscape-in-florida/>

Picture 2:
<https://www.fairamountfoodforest.org/what-is-a-food-forest.html>

Sources used in this lesson:

Community Food Forests
<https://communityfoodforests.com/free-resource-interactive-school-activity/>

NEW YORK RESTORATION PROJECT
(NYRP). <https://www.nyrp.org/en/resources/>

#10 Habitat map



Description & background:

A habitat map shows the geographic distribution of different habitats and species within a particular area, it is a great starting point to work further on urban green. This exercise introduces concepts like biodiversity, habitat,...

Keywords:

Biodiversity, habitat

Goals for student:

Develops group work skills, builds awareness on the importance of trees in a city.

Gains knowledge on indigenous species, ecosystem, mapping

Suitability:

Summer, autumn, spring

This lesson includes indoor and outdoor parts

Fits in subjects:

Geography, biology, social sciences

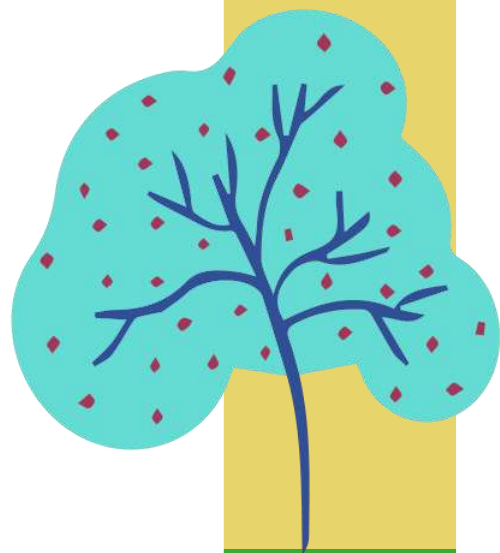
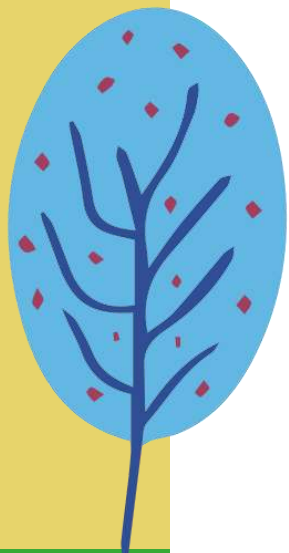
What do you need?

Materials:

Printed maps of the neighbourhood or school, ballpoints, markers, app like Plantsnap, species identification maps, (smartphones if available)

Preparation:

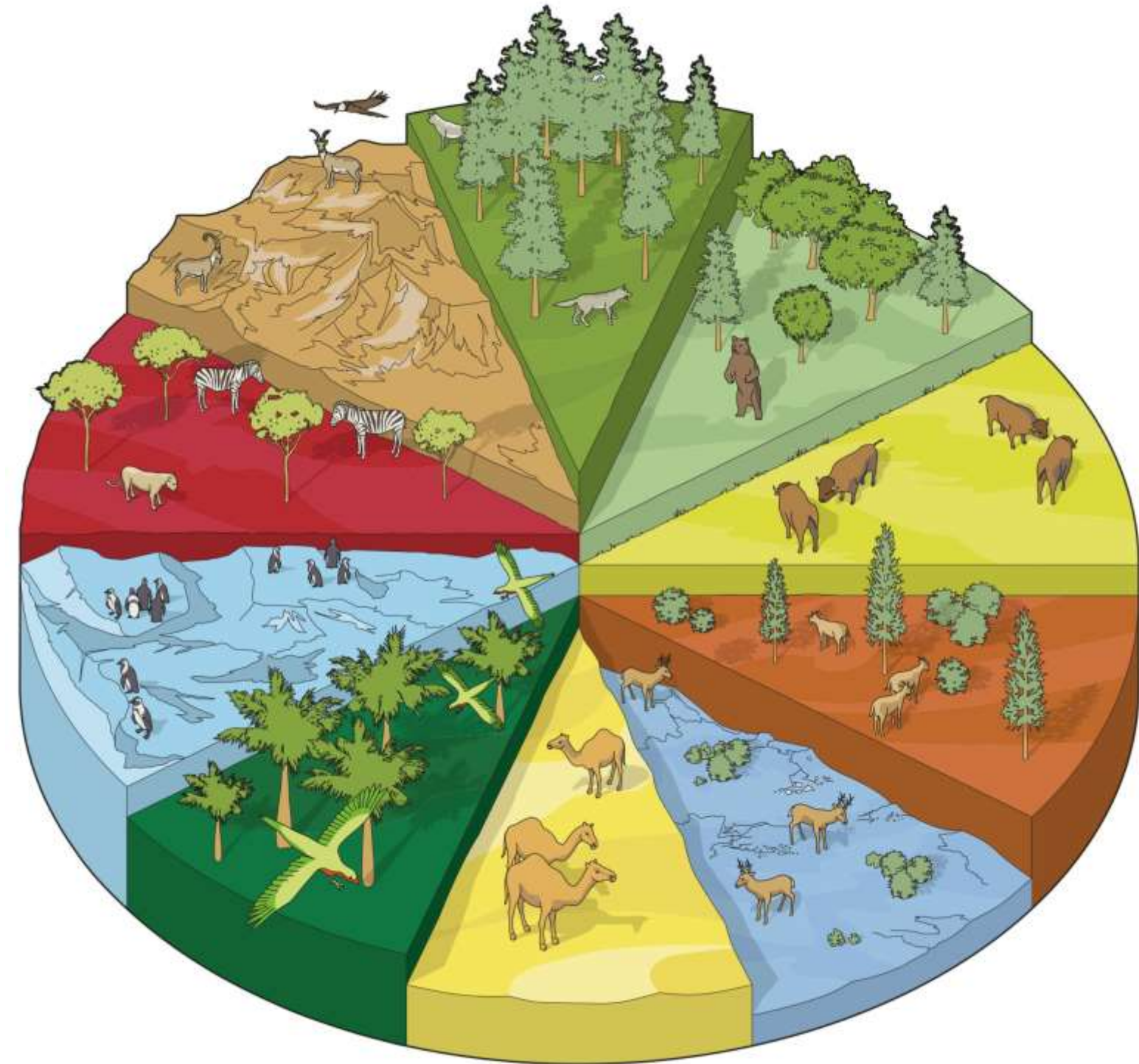
Decide which map will be used for the mapping, how big the researched area will be (depends on level and age of students). This can be the school itself, the close neighbourhood or more neighbourhoods in the city. Make this very clear and make sure it is achievable.



#10 Setting the scene

A habitat is the place or environment where a plant or animal naturally or normally lives and grows. It provides the animal with food, water and shelter. There are many different sorts of habitats around the world; from forests to grasslands and from mountain slopes to deserts. Different habitats are a home to different animals.

A city is a habitat that is home to many different animals, plants and people. A lot of them live very close to each other, which makes it a very special, always changing environment.



The different land habitats that exist on our planet

#10 Setting the scene

Biodiversity is the amount of different species, and the variety of different species on a certain surface. It is often used as a standard to measure the health of a biological system. The more biodiverse an area, the stronger the ecosystem. Biodiversity makes an area stable and healthy; it underpins the health of the planet and has a direct impact on all our lives.

Unfortunately, a lot of species (plants and animals) are becoming extinct (the last of the species have died). Not only is this a big problem because it can be considered morally wrong that humans as a species cause the destruction of other species of the planet. Reduced biodiversity also means that millions of people face a future where food supplies are more vulnerable to pests and disease, and where fresh water is in irregular or short supply.



This duck and rabbit adapted their life and habitat to the city.

#10 Setting the scene

Biodiversity is threatened, but even in the city different plants and animals are closer and more present than you'd think. Protecting biodiversity starts with knowing what is out there.



Human activity is threatening biodiversity, Doel-Belgium

Further reading: [Native and non-native species](#), [Web of life](#)

#10 Activity

Go out in your group to map the environment. Equipped with map; markers; species identification maps; apps to indicate where there are trees, bushes and animals.

Indicate the species you can find and try to define which ones they are. The identification maps or apps like Plant Snap and OBSidentify can be very useful!

Come back and discuss the results.

- If the groups had to research different area's; every group presents (short) what they have found where. Put the maps together and make it to one definitive map.
- If the groups worked on a big area which you divided into smaller parts, bring the parts together and discuss what you can learn about that habitat. (It has many broadleaf trees, few wildflowers, diversity of nesting birds..)
- If the groups researched the same area: Discuss the findings in group and come to one definitive map.



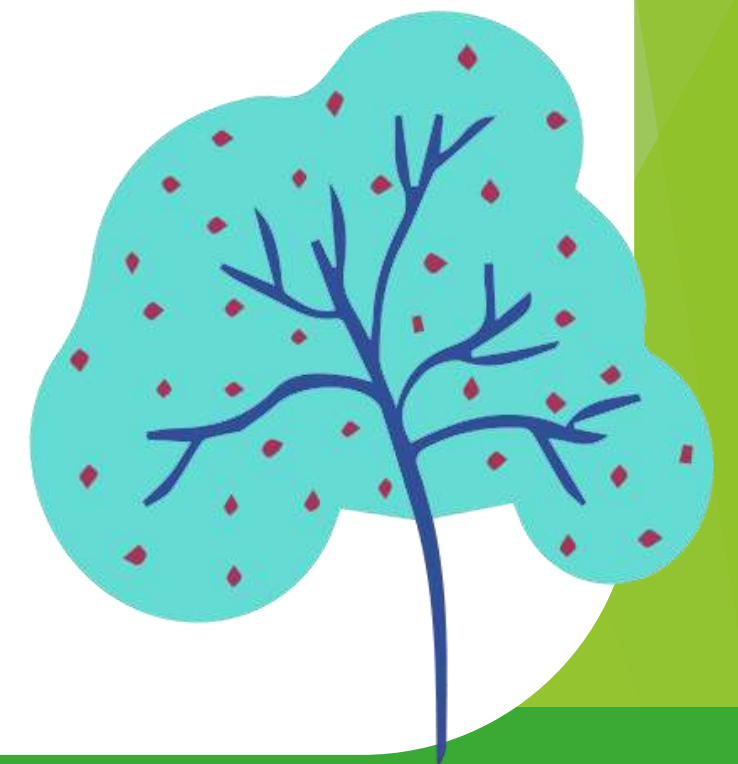
An example of a self-drawn habitat map

#10 Reflection



Try to answer the questions below through discussion in group

- Are the results as expected?
- Do the students think there are a lot of trees and green in the city/school area? (scale too much- too little)
 - In all cases (enough, too little, too much), discuss the opinions and motivate why you feel that way.
 - Think about this from the point of view of:
 - Fauna
 - Flora
 - Yourself



#10 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Are there spots on the map where the class thinks trees (or green) can or should be added? Or the other way around; places where trees and greenery should be removed? Indicate these on the map. Discuss why in both cases.

Two steps

Indicate spots on the map where trees can be added. Make an appointment with the school board or municipality to present your plan. Don't forget to motivate why trees are important in that specific spot.



#10 References and further inspiration

Sources used for this lesson:

Photo 1: DK Find out UK;

<https://www.dkfindout.com/us/animals-and-nature/habitats-and-ecosystems/land-habitats/>

Photo 3: Photo by Marcus Bellamy on Unsplash

<https://unsplash.com/photos/BG3Zz64sOC4>

Photo 4: Yves Adams- Vilda,

<https://vildaphoto.net/nl/combosearch?q=&cats=570#p134326-r1>

Photo 5: Yves Adams- Vilda;

<https://vildaphoto.net/nl/title?q=Konijn+in+de+stad#p140861-r1>

Photo 6: Schatkist van de Natuur, BOS+

Lesson inspired by

- Habitat mapping: [http://www.leafmexico.org/pdf/B_Bio diversidad/Biodiversidad+Worksheet+Habitat+ Mapping.pdf](http://www.leafmexico.org/pdf/B_Bio%20diversidad/Biodiversidad+Worksheet+Habitat+Mapping.pdf)
- Biodiversity and You: https://wwf.panda.org/discover/our_focus/biodiversity/biodiversity_and_you/

#11 Finding peace of mind in the city

Description & background:

This exercise will address anxiety about the events in the world, like climate change, environmental threats and the covid-19 pandemic. The activities introduce the students to mindfulness in nature as a self-care practice.

Fits in subjects:

Arts, ethics, social sciences, health

Keywords:

Climate change, pandemic, environmental problems, threat, fear, anxiety, personal development, mindfulness, self-care

Goals for student:

Develops abilities to recognize your own thoughts and introduces the idea of regulating one's thoughts and emotions. Encourages to connect with nature in a mindful way.

Suitability:

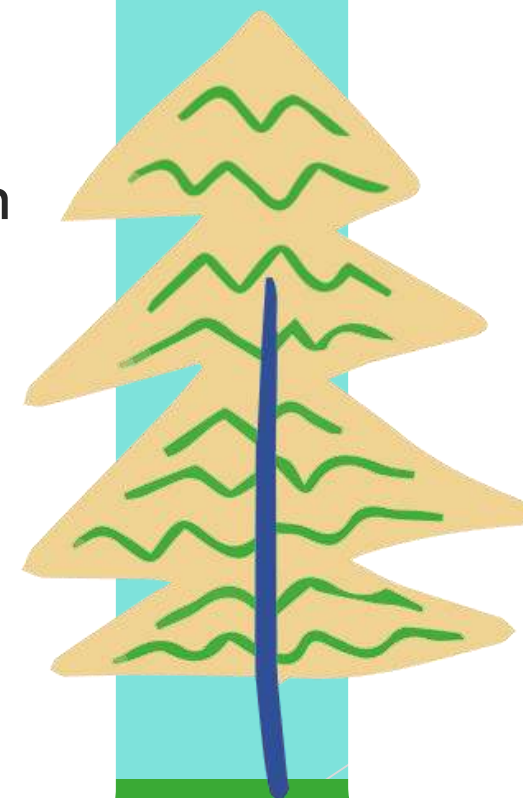
Spring, summer, autumn, winter
Outdoors

What do you need?

Materials:

Paper and pen
Read section on Climate change anxiety (in [Ch 6 of Teachers Inspirational package](#))

Preparation: /



#11 Setting the scene

Seeing and hearing about climate change and living during the covid-19 pandemic has been and continues to be a lot to cope with. For some youngsters, the changes have been enough to cause them anxiety and sleepless nights.

Anxiety due to environmental problems and threats refer to a difficult feeling inside us. Climate anxiety is part of the wider environmental anxiety phenomenon in which the state of the world affects mental health. This is not a strange or unreasonable reaction, as the world is going through some major changes. Climatic or environmental anxiety can however become a problem if it becomes so severe that the person becomes paralyzed.

It is therefore very important to take care of yourself, realize when you are feeling anxious and take stock of what is true and what is something your mind has made up.

#11 Setting the scene

You see, your thoughts are happening in your mind, just like your breath is happening in your body. Thoughts come and go and impact how our day shapes up to be. If we are thinking sad thoughts, it is hard to find something fun about anything. If we are thinking happy thoughts, the day will most likely turn out happy. However, thinking only happy thoughts is almost impossible as we cannot control what happens in our lives. While we might think we have little or no control over our thoughts, it is not true. We can learn to manage our thoughts, but it takes practice to first notice them and then learn to manage them.

You might have heard about mindfulness. Contrary to what you might think, it is not that difficult or even serious. What is important though, is that you enjoy it, otherwise it is hard to keep up the practice and become good at it. The entertainment we engage in through television or social media may keep our attention focused, but it also over-stimulates our minds. One can see its impact in depleted attention spans, reduced concentration, and poor memory.

As you might have learnt in the lesson **Forest for rest**, spending time in nature is good for our minds. Combining mindfulness to being in nature is a powerful combination as in nature, mindfulness happens almost on its own.

Further reading: [Dr. Forest at your service](#) , [Colours of the forest](#)

#11 Activity

All the activities mentioned underneath integrate elements of nature, which makes it easy for beginners to access the concept of mindfulness. On top of the benefits of mindfulness, the participants will be able to enjoy the many health benefits of being outdoors.

Mindful Listening: Language of the Birds

What is the difference between regular bird-watching and mindful birding? While our eyes make up the primary sense for the former, the most important sense for mindful birding is our ears. Rather than counting the number of different birds we can see, our focus is on learning how to create calm with the help of the birds.

We recommend keeping all cameras and phones away. Once you find a space that has sufficient bird activity, ask the group members to find a spot for themselves and sit in silence.

(Continues on the next page..)

#11 Activity

Mindfulness Activity Prompts

Listen to the closest bird.

Listen to the farthest bird.

Listen to the birds in different directions.

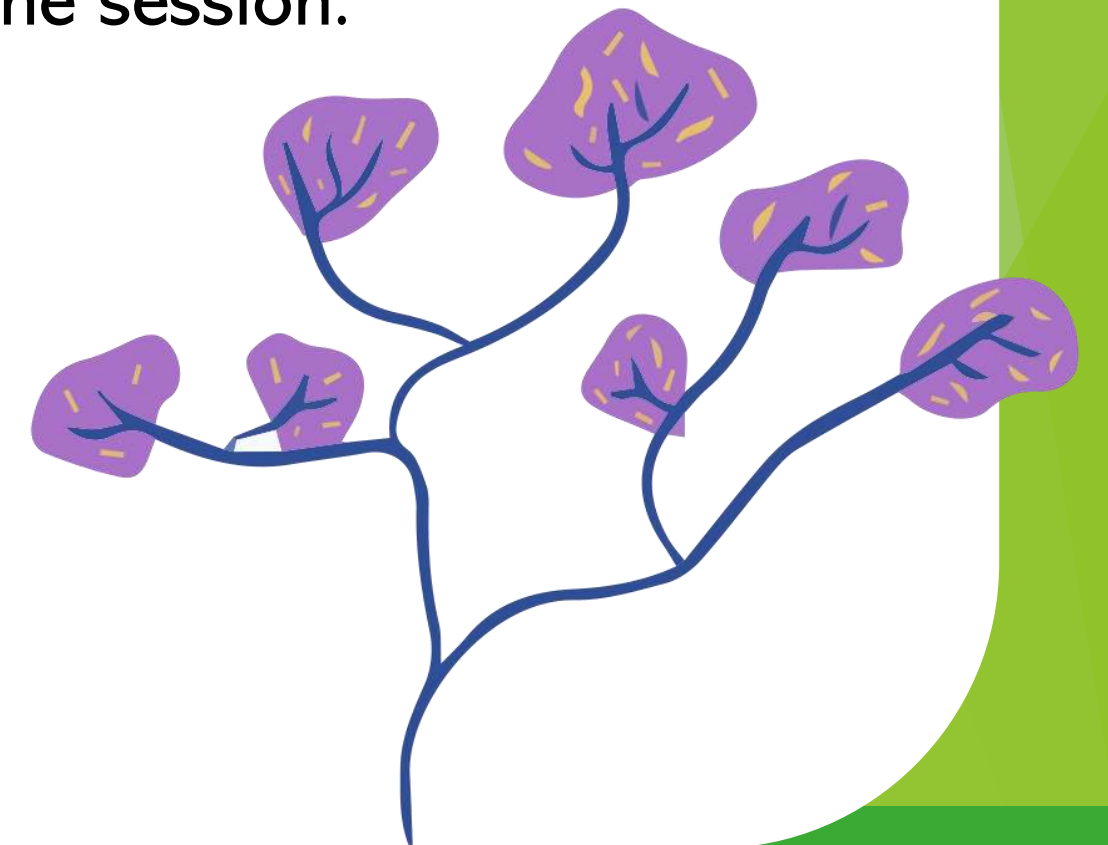
Listen to the silence in between the birdcalls.

Listen for conversations. Follow the sound of a particular species and imagine what the birds are trying to say?

The group can share their stories, insights and learning at the end of the session.

Listen to conversations. Follow the sound of a particular species and imagine what the birds are trying to say to each other.

The group can share their stories, insights and learning at the end of the session.



#11 Reflection

Spending time with the birds in a mindful way leads to some beautiful insights. Just like the birds, sometimes we have to let our minds soar above our day to day worries and see our lives from a higher perspective. Mindfulness allows us to do that, helping us to discover wiser choices for our future.

After the activity, discuss your experience with your group.

Like a muscle, our brain also responds to training. Try to do this or any of the other exercises once a day or week and see what changes for you and your group.



#11 Take it a step further: one step

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Mindful Immersion: Art of Leaves

Here are 2 creative mindfulness activities that make use of the leaves for mindful immersion. These activities help you create some unique artworks, especially in the autumn.

Leaf Tracing: Pick any leaf. Choose a simple one or a complex shape. Trace the outline of the leaf with your eyes as slow as you can. Move from one edge of the base, all the way around to complete the loop. This exercise is an excellent way to slow down your thoughts. (on a rainy day, you can also bring some leaves indoors beforehand)

Leaf Collage: Group members work in pairs. Using different leaves to create a mythical or magical forest creature. Use the imagination to escape into a hidden world. This simple exercise raises the energy levels of the group. So the group leader must ensure that the silence of the group does not get lost.



#11 Take it a step further: two steps

Do you want to do more with this lesson? Take it a step further and get to action!

Two steps: Mindful Appreciation: In Search Of Wonder

(on a rainy day, you can also do this indoors using materials that are present in the room)

This Mindfulness exercise involves focusing on a positive thought or emotion. It helps to shift our attention from the negative cycles of our mind that pull us down, to a more positive frame of mind. For this activity we can either use the treasure-hunt model where the group goes out into nature and collects object based on a pre-given list, or we can ask the group members to just take a photograph of the objects. For larger groups it is better to use photographs as it creates a lesser impact on the surrounding. The simple rule all participants need to follow is that you can only take one photograph per item on the list. By restricting the number of photographs, we get the group members to be more mindful of each shot they take. With this single rule we can turn our device of distraction into a mode of meditation.

Here's a list of recommendations. Feel free to create your own.

One thing that makes you smile. One thing that brings you calm.

One thing that fills you with hope. One thing that makes you curious.

One thing that fills you with awe. One thing that you are thankful for in nature.



#11 References and further inspiration

Sources used for this lesson:
(no pictures)

Sources used for this lesson:
All the activities in this lesson come from Healing Forest: www.healingforest.org

#12 Distribution of greenspaces

Description & background:

In this exercise the distribution of greenery in a city is discussed. Not every place in a city is equally green or has accessible greenspaces for its inhabitants. The students learn how green their school area and home area is. We want to focus on the social benefits of green neighborhoods here and make a link with the historical changes in the city according to green. How green is an area? Was it always like this? Environmental justice is also introduced as not everyone has the same access to greenery in the city.



Fits in subjects:

social sciences, history, geography

Keywords:

City, neighbourhood, accessible green

Goals for student:

Develops understanding about interconnectedness of everything in the natural world; impact of human actions to nature
Concepts: web of life, food chain, eco-system, biodiversity, ecosystem diversity



Suitability:

summer, spring, autumn-
indoor & outdoor

What do you need?

Materials:

pen & paper

Preparation: good communication skills and inquisitive mind



#12 Setting the scene

Cities are continuously changing. Inhabitants come and go, buildings are built, roads are created, and the total area of the city keeps growing. Many cities still lack green oasis and greenspaces that are close enough for every citizen to access. Too often the nature places are tucked away in the edges of the city, where it takes too long to travel, through all the traffic.

Several studies show that cities benefit of green spaces and nature in several ways. Cities become more resilient against climate change (see f.ex. [How trees make our cities livable](#)), the greener they are. This is among other things because trees and plants cool a city down and absorb rainwater. Research has also shown that the presence of green plants and activities in natural surroundings contribute to safer neighborhoods where there is less crime and better feeling of community. In this exercise we want to focus on the social benefits of green neighbourhoods, i.e., how the presence of greenery in your neighborhood affects the human interactions.

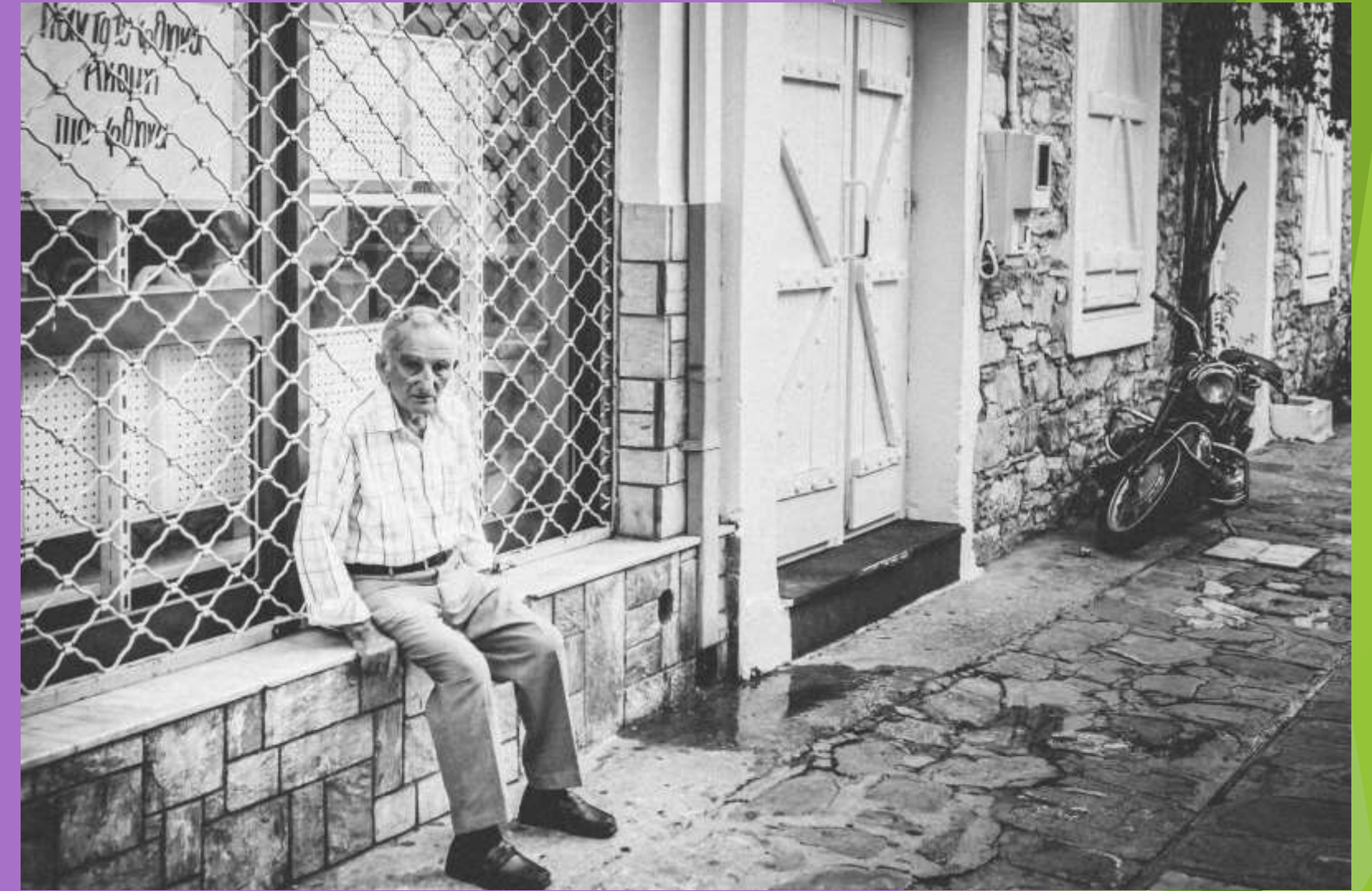
#12 Setting the scene

During the Covid pandemic, we have seen even more clearly across the world how people turn to nature in the time of need. Across the world we have witnessed how citizens who were suddenly finding themselves without the usual things to do indoors, flocked outside to keep active, to have something to do, and to work on their overall wellbeing. As a result, in many cities, public parks and playgrounds had to be closed because too many people flocked to them! It is clear that we need to increase the green spaces in our cities. Access to nature is a human right!

Further reading: [Water cycle in the city](#), [How trees make our cities livable](#)



#12 Setting the scene

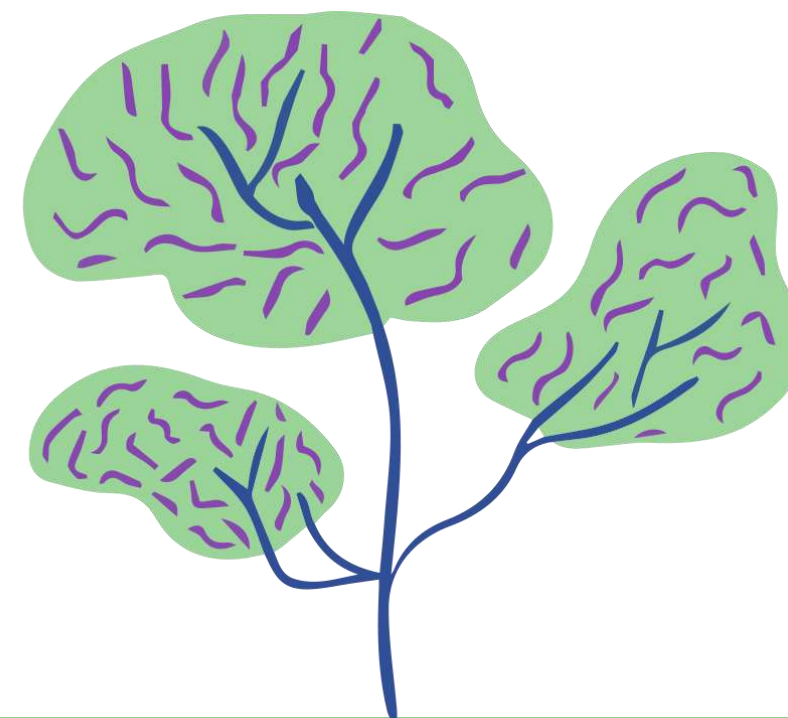


These kids will experience the city in an entirely different way than the older gentleman.

#12 Activity

In this exercise we invite you to think about how green your own neighbourhood is. This exercise is nicest to do outdoors where you have lot of space. You can also do it in the gym of your school. Start at one end of the school. Students stand in line facing the teacher (or anyone who is reading the sentences out loud). The reader reads out the sentences. If the sentence suits your situation and the answer in your case is yes, you take two steps to the right. If not, you stay put. One student or the teacher keeps track of how many students answer what on which question.

- I don't have a garden
- I have a large public park with trees close to my house
- There are trees in my street
- I have a terrace/balcony at my house
- I have a small public park close to my house
- I have three different species of trees in my garden
- I have plants (indoors) at home



#12 Activity

Everyone individually fills in what is applicable. On the next page you find the sentences in a raster. After you indicated this for yourself, take this home and go ask about the same sayings to your parents, grandparents, older neighbours (people that live in your street for a longer time, at least for 10 years).

Have the person you are interviewing answer these in the context of the place 10 years ago. Especially if the person who you interviewed is from somewhere else originally, you might want to ask about how this place is different to their current living area and how that makes them feel.

Perhaps you might want to record the interview on your smartphone, if it is okay for the person you are interviewing. You can listen to the interview together with your classmates in the class.

Write your findings down: your own answers and those of the person you interviewed – what differences can you notice? What do you think causes these differences (age, gender, culture, whether they like nature...)?

What do you learn about yourself as a result (e.g., is it important to have trees in your street? Do you get to spend enough time in natural environments?)



#12 Activity

Statement	Yes	No
I don't have a garden		
I have a large public park with trees close to my house		
There are trees in my street		
I have a garden		
I have a terrace/balcony at my house		
I have a small public park close to my house		
I have three different species of trees in my garden		
I have plants (indoors) at home		

#12 Reflection

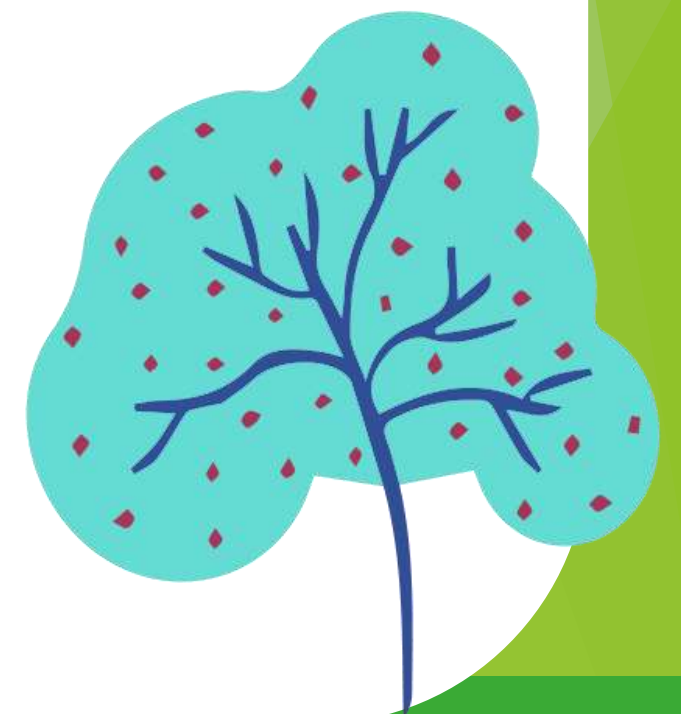


How is the difference in greenspaces evaluated by the students and the older persons?

Every student presents in short what the most remarkable differences are between you and the older interviewed person. The answers of the interviewed people are also written down in a table and compared. It is also possible to use the findings to inspire an artwork, a poem, an essay.

Is there an overall conclusion to be made for everyone? Was there more or less greenery in your neighbourhood 10 years ago?

What do you think the saying "Access to nature is a human right" means?



#12 Take it a step further

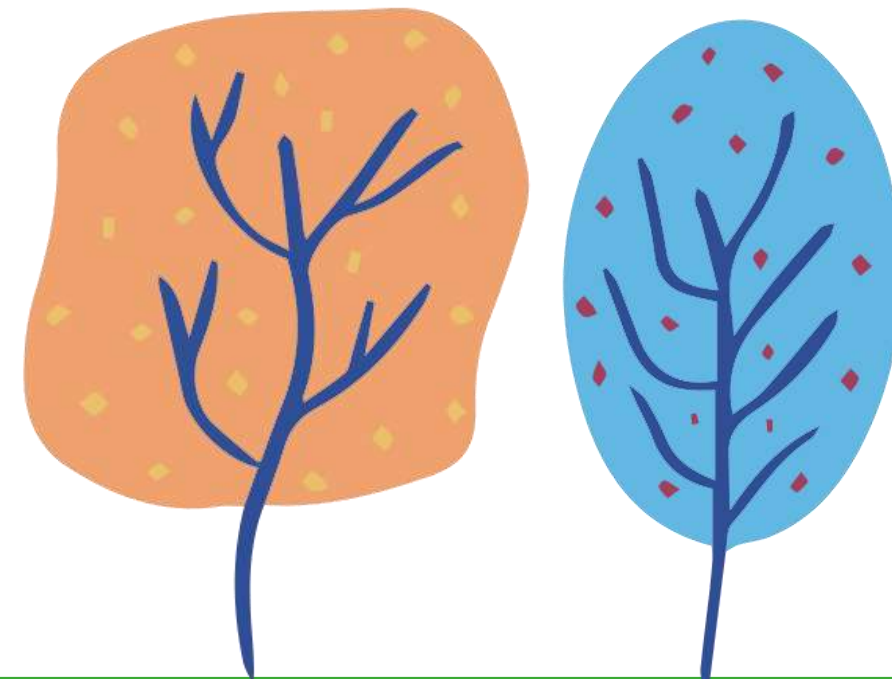
Do you want to do more with this lesson? Take it a step further and get to action!

One step

Based on the findings in the table, would you intervene in your street/neighborhood to make it greener? Indicate on a map the spots where you have concrete ideas. List up all the potential benefits you can identify from adding greenery here (think of people, plants, animals, ecosystem services..)

Two steps

Look up the email of your local government and email your plan to them. It's interesting to tell that the inspiration for this plan came from a comparison with older inhabitants from the neighbourhood.



#12 References and further inspiration

Sources used for this lesson:

Picture 1. Fas Khan on Unsplash,

<https://unsplash.com/photos/zydtqCdOT3w>

Picture 2. Nick Karvounis on Unsplash,

<https://unsplash.com/photos/qepOTcXllbw>

Sources used for this lesson:

Green cities for a sustainable Europe. SOCIAL

COHESION:

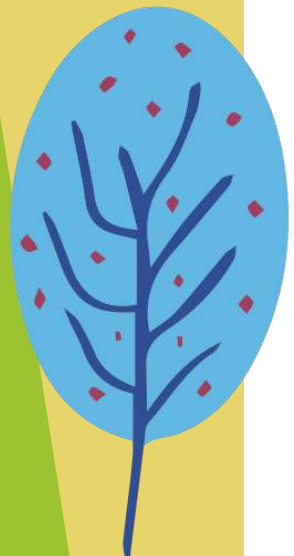
<https://www.thegreencity.eu/themas/social-cohesion/>

#13 (non-) native species



Description & background:

This exercise learns to recognize different kinds of species in your neighbourhood. The students will learn the concept of native and non-native species for the area where they live and what it means. The problem of invasive species will be touched upon as well. Start this exercise when you've been working on plants already (for example after the 'habitat map' or "resistant trees"). This will make it easier to recognize plants and species.



Keywords:

Climate change resistant, urban, resilient

Goals for student:

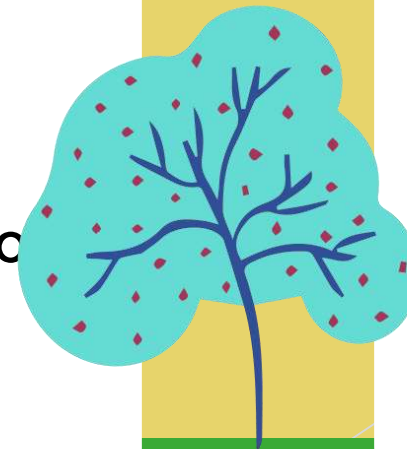
- Develops an understanding of terms as native, non-native, invasive
- Gains insight in consequences of planting certain species, the species in his/her area

Suitability:

Summer, spring, autumn, indoor and outdoor

Fits in subjects:

Biology, geography, religion



What do you need?

Materials:

list of non-native species for your area and a list of invasive species for your area, plant guide, (app like plant snap, smartphones)

Preparation:

Contact the conservation centrum of your area and ask about the native species of the area for a list of native plants in your area. Ask them to come to the class to provide more information on this subject or ask them for more information so that you can explain this to the class.

#13 Setting the scene

The difference between native and non-native species seems easy to explain but a lot depends on the definitions that are used. In a nutshell, native species are species that are from a particular place without human intervention – humans didn't put them there directly or indirectly. This means that “native” can vary a lot based on what scale one is considering, and whether there are records of pre-settlement organisms (think fossils). Mostly, thinking about whether or not a species is native in terms of a state, province, or habitat type is most useful, though there are situations where bigger or smaller scales are applicable.

These days it's hard to define which species is native and which isn't. Over the years a lot of species have been dragged around and circulating in different areas.

A lot of species look native but aren't. For example; a Belgian looks at potatoes as the most 'Belgian' thing, but this plant is only truly native in South- America. One way to define if a species is native, is to look at how it fits in the food chain of the location it is growing. Species evolve over the years, so if a species fits in the food chain it can be considered a native species.

#13 Setting the scene

A rhododendron is a beautiful native mountainous shrub from the Himalayas. In Europe it is a popular garden plant that has escaped the gardens and is growing happily in the forests now. However, its role in the forest ecosystem is questionable as it has not evolved in the Europeans forests.



#13 Setting the scene

Is it a problem if a species is new and not native? No, because most of the non-native species cause no harm. But one in thousand non-natives is threatening. These are called invasive species and are a problem because they can cause harm to environmental or human wellbeing by out-competing, i.e. winning in the fight for resources like space, light, water and nutrients for the native species. Some non-native species are at the same time useful and harmful.
A native species can never be invasive.

How do non-native species spread? The different plants' seeds spread through different means. They may be windblown, rain splashed, carried by animals, or moved in soil or water. Almost all short-distance spread is through these natural dispersal mechanisms. However, long distance spread is almost always human assisted. Because long distance spread takes the species a long way from home, the resident plants and animals are not often prepared to cope with their new neighbor. Natural enemies are missing, and host species often lack the natural defenses necessary to survive an attack by the introduced species. Once introduced, aggressive species are free to expand their range using their short distance dispersal mechanisms with a competitive advantage over native plants and animals due to the lack of natural enemies.

#13 Setting the scene



The red oak is native in the East of America, but since years widespread in gardens and forests in Europe. This is a fast-growing tree who conquers a lot of native species in Europe.

In that way this tree is sometimes seen as invasive. But, its autumn foliage is breathtaking.

#13 Setting the scene

Are humans invasive? The shortest answer is “yes, absolutely.” We are extremely mobile and nowadays have an immensely negative impact on our environment and our own health. We are the only species that actively tries to destroy its own habitat. We are a problem, to the point where talking about sustainable development, which means considering nature and the environment in all our activities so it will not get harmed, is an expired way of thinking. We need to restore nature from the degradation we have brought to it.

Luckily, there is one key element of our invasiveness that makes us special: we have problem-solving abilities and have the power to change what we do and how we do it. On small scale, i.e. what one can do personally in their own life, we can clean our boots when leaving one nature area and entering another to spread of “hitchhiking” invasive reproductive parts like seeds and eggs. We can also think about our consumption habits, resources like energy, food and material things and even decide to have fewer children. Thinking big, we can decide to try to influence policy making by following what is being decided in our city and national governments and elect officials who care for the environment. We can get involved in youth politics as well! A lot of other invasive species don't get to make choices like that.

Further reading: [Native and non-native species](#)

#13 Activity

Each student chooses 4 different plant species on their way from home to school. They can choose which ones they pick. It can be a tree, a flower, a small or big plant.

(You don't have to literally take it with you. You can also draw, note down its name or take a picture of it.)

Before you get to work answering the questions, take a moment to study the tree or plant you have chosen, and study its leaves, its trunk or stem, the shape of its leaves, the shade of its colors. Study its scent by smelling it and feeling how it feels under your fingertips. Though coming into contact is good for our immunity, make sure not to put any pieces of the plant in your mouth in case it is poisonous.

#13 Activity

Everyone indicates their found species on a map and finds out the name of it via an (online) plant guide. Look on the list if your species are native or non-native in your area.

Answer the following questions;

- What kind of species did you identify? How many are plants, how many are trees and how many are shrubs?
- How many of the collected species are (non)-native?
- How many of the species are invasive?
- Indicate where the species were found, define in categories; private garden/park/ along the road.
- Can you make a link between the found places and species?

#13 Reflection

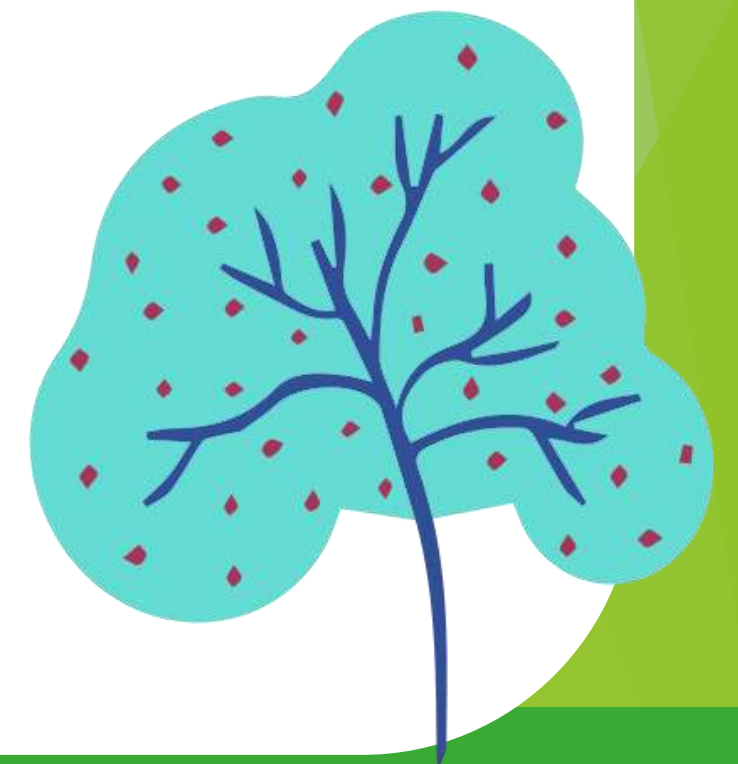


Talk about the following questions and try to find an answer together:

Are humans invasive? Where are humans native?

When students learn about these concepts, it's likely that this question will come up.

Should we let the non-native trees take over the native ones? What would be the benefits and losses from losing the native species?



#13 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

Go look in guides and on the internet where the most common non-native species in your area originated from. Think about the similarities and differences of these areas and what makes it that they thrive in your area.

Two steps

Go to the conservation centre or contact a nature organization to explore what is being done in your area to fight the invasive plants.

More

Find out which animal species are native to your area.



#13 References and further inspiration

Sources used for this lesson:

Picture 1: By Yoksel 🌿 Zok on

Unsplash: <https://unsplash.com/photos/OakyeSJYrWw>

Picture 2: By Hans on Pixabay,

<https://pixabay.com/nl/photos/red-oak-herfst-bladeren-oranje-61974/>

Sources used for this lesson:

Thoughts and

Awe: <http://www.thoughtandawe.net/biology/native-non-native-invasive/>

PlayClearGo:

<https://playcleango.org/invasives-101/>

#14 Watercycle of urban forests

Description & background

This lesson introduces students in a hands-on manner to the value of forests for the Earth's cycle from understanding the path of water in a tree, and the way that trees and urban forest ecosystems act as water redistribution systems.

Fits in subjects:

Natural sciences, maths, physics, chemistry

Keywords:

biodiversity, old tree, ecosystem services, carbon sequestration, heat island effect, urban pollutant, fine particulate,

Goals for student:

Develops understanding of complex processes and interconnections.

Develops a clear idea that forests redistribute water and are therefore fundamental for human life. Gains an experience in caring for a living being.

Suitability:

Indoors, spring, summer

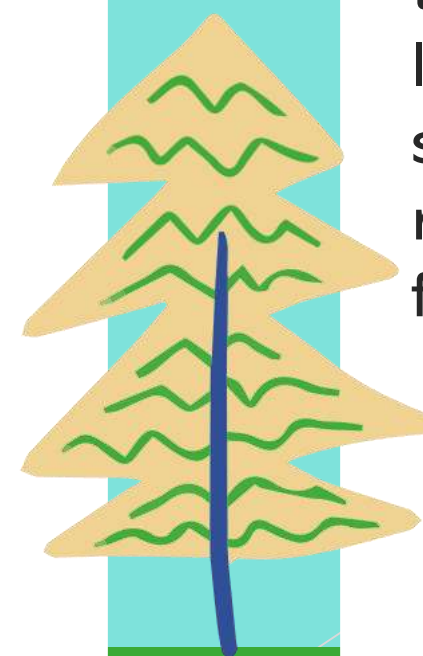
What do you need?

Materials:

Seeds of same species, pots, Soil, plastic bottles
Note taking materials

Preparation:

Make space for planting in different light conditions. Make sure the plants can be located in places where the students will be able to return to caring for them for weeks at a time.



#14 Setting the scene

In a large city, a single tree captures and redistributes an average 6500 liters of rainwater each year. Without the tree, all of that water would fall to the ground, and much of it would become runoff. During a heavy rainstorm, the sewers could overflow from pollutant carrying water running too fast on the paved streets into nearby waterbodies and overflowing the city. But, with the help of trees, the water is captured, stored and re-used as part of the natural water cycle, soaked up by trees and returned to the atmosphere.

In a large city with estimated 200,000 street trees, 400,000 park trees and hundreds of thousands of privately owned trees, it is an impressive amount of water that gets captured by the urban tree canopy. The more trees we add to our landscape, the less pollution will flow to our waters. And with the threat of climate change and the invasive pests, conserving existing trees and planting new trees is more important now than ever.

#14 Setting the scene

Here's a more detailed explanation of how trees mitigate stormwater runoff in the city:

Interception — Rain falls on the tree's leaves, branches and trunk. Some of it is absorbed by the tree, and some of it evaporates back into the atmosphere. The rest falls through to the ground, but at a much slower rate than it would otherwise. This helps reduce “peak flows” during rain events and also helps prevent soil erosion.

Infiltration — Water that falls through the tree canopy soaks into the ground and gets absorbed by the tree's roots. By soaking up water from the ground, trees add capacity for the soil to store even more stormwater. As they grow, the roots also help break up compacted soil, which allows water to more easily move downward into the groundwater table.

Transpiration — The tree draws water out of the ground to use as fuel for photosynthesis. The water is later released back into the atmosphere as water vapor. This normal part of the water cycle also helps to cool the air and reduce high temperatures in the summer.

Evaporation - Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies.

Evapotranspiration - is the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere. Evapotranspiration is an important part of the water cycle.

Further reading: [Water cycle in the city](#)

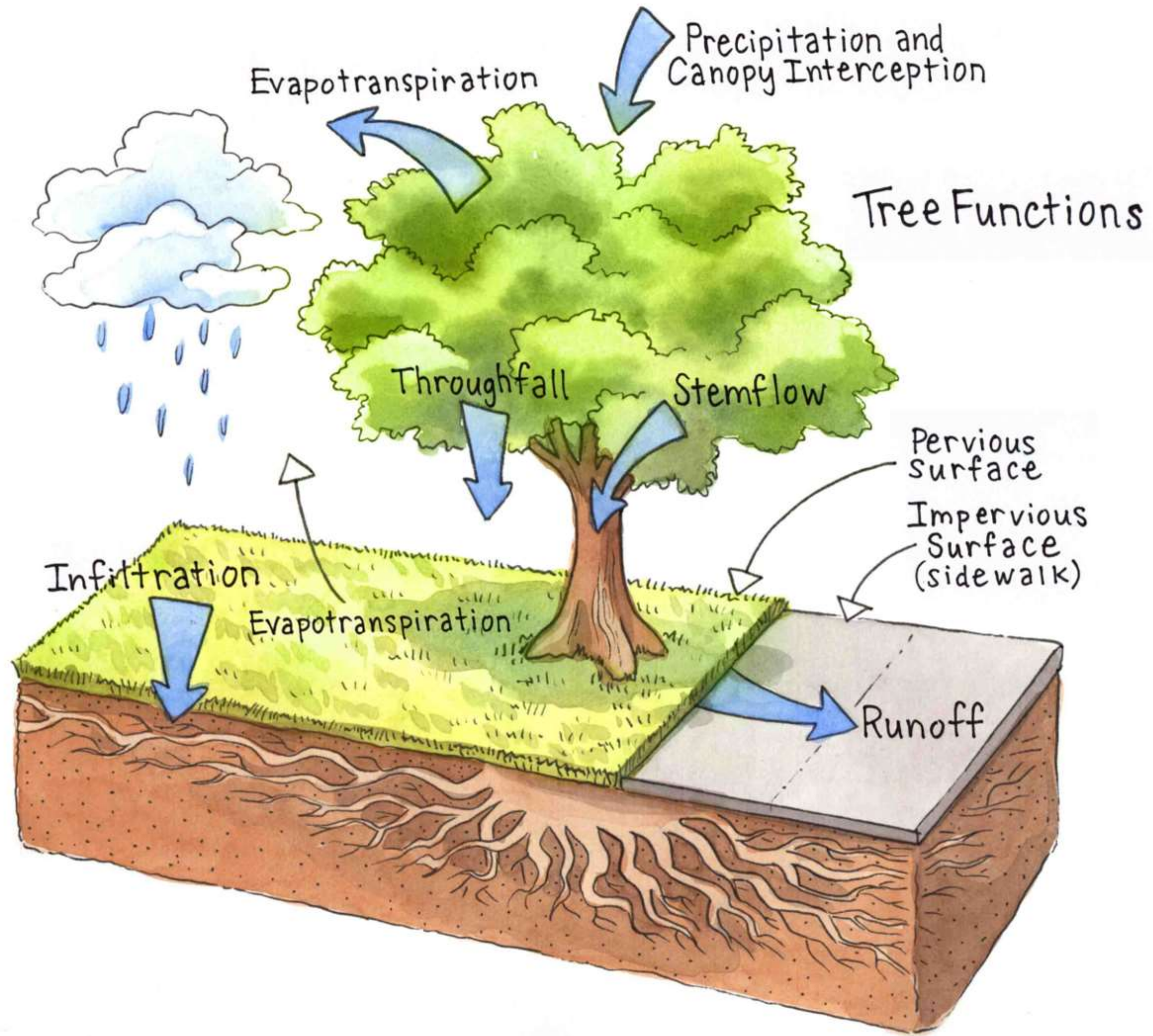
#14 Setting the scene



Transpiration



Evaporisation: water evaporates into the air



Tree and water cycle

#14 Activity

The class is divided in groups of 2-4 students. Each group plants the seedlings of a relatively fast-growing plant in the class, e.g., Jade Plant.(*Crassula ovata*), spider plant (*Chlorophytum comosum*), Snake Plant (*Chlorophytum comosum*)

- Water the seedlings by placing bottles upside down in the soil and record the water intake of each plant.
- You need to record often enough that not all bottles are empty when they are recorded – you should refill as soon as empty to record intake differences; the teacher should thereby follow water levels and adapt the recording schedule.

Each team of students notes the water intake for “their” plant. All students use the same recording table, created in class and copied or glued in your experiment notebook, to note how much water is given and when (the unit used should be standardized, e.g., 1 l for younger students). In addition to water in-take recording, you can also record the height of the plant and the number of leaves appearing.

Practical:

- Do at least 3 recordings (1–2 weeks) for 10 min. each time /whenever plants need watering
- In teams of 2–4 students

#14 Reflection

Try to answer the questions below in group:

- Which plant seems to be growing fastest? Why is that? What internal and external factors impact that?
- Which plants seem to need most water? Why is that? What internal and external factors impact that?
- Which plants use less water? Why is that? What internal and external factors impact that?
- What affects the speed at which the evaporation happens ?
- Where does water go when we water plants? Along with the water intake and growth?
- How does it feel to be taking care of the plant?
- How do you feel when tending to the plants and witnessing their growth or condition (also setbacks).



#14 References and further inspiration

Sources used for this lesson:

Picture 1: Bart Zimny on Unsplash,
<https://unsplash.com/photos/W5XTTLpk1-l>

Picture 2: Jai Sipani on Unsplash,
<https://unsplash.com/photos/R1jtRLCMYow>

Picture
3: http://www.gicinc.org/trees_stormwater.htm

Sources used for this lesson:

Discovering Forests: <http://www.fao.org/3/i6208e/i6208e.pdf>

Mississippi Watershed
Management Organization: <https://www.mwmo.org/news/protect-water-resources-plant-tree/>

#15 Colours of the forest

Description & background:

You will learn about the processes of changing colours in autumn. You will experience and focus on the beauty and differences in nature by using different senses.



Fits in subjects:

Arts, biology

Keywords:

Colours, autumn, chlorophyll,

Goals for student:

Develops creativity; Gains sensory experiences, knowledge on biological concepts; Builds focus; Builds immunity by coming into contact with natural materials in nature.



Suitability:

autumn- outdoor

What do you need?

Materials:

All materials you can find in natural environments. Pupils should wear suitable clothing for safe and comfortable movement.

Preparation:

Choose a place to go to with a lot of trees and the right period, when the leaves are coloured. Print the colour rows and cut them per row. This is easier to work with.



#15 Setting the scene

Many people's favourite season is autumn because of the beautiful colours of the autumn foliage.. But why do the leaves all of a sudden change colours before they fall off?

During the summer growing season, leaves are packed with chlorophyll. That is the green, light-absorbing pigment used for photosynthesis. The onset of autumn prompts chemical changes in the leaves of deciduous trees and shrubs. They start to prepare for winter dormancy, when days get shorter and cooler. As the chlorophyll breaks down, the green fades to reveal a bonfire of other colours.

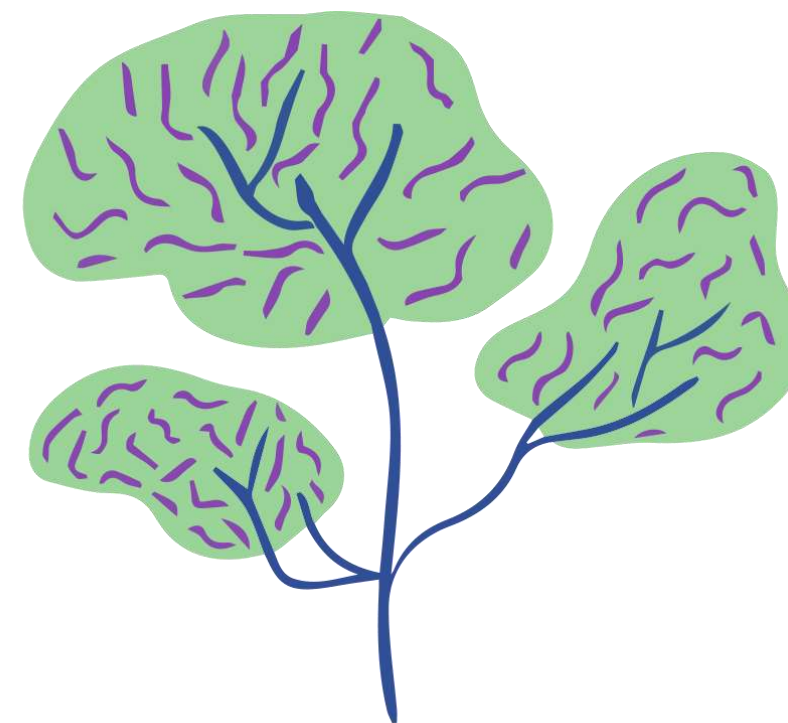
- Yellow and orange: The appearance of yellow and orange shades in autumn leaves indicates the presence of carotenoids, pigments that all summer have been masked by the dominant green chlorophyll and are only revealed as the chlorophyll breaks down. Carotenoid pigments also make carrots orange.
- Reds: Unlike other colours, reds and purples are not always present in autumn leaves. These shades are made from anthocyanins, pigments produced from sugars trapped in the leaves before they fall. Some plants are bred to have red leaves all year round, hiding the green chlorophyll in the leaves

#15 Setting the scene

Different plants have different pigments. Other than being beautiful to look at, they fulfil extra important functions for plants.

They protect them from harmful UV radiation, help to limit the damage caused by stresses such as excess salinity and drought, and are present in fruit and flowers, to attract specific animals, including humans!

Further reading: [Colours of the forest](#)



#15 Activity

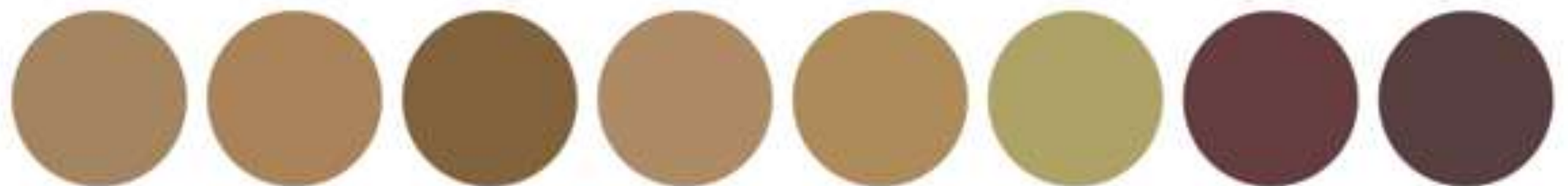
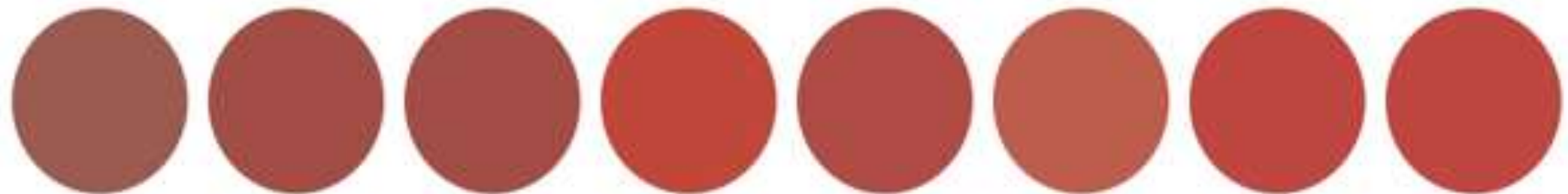
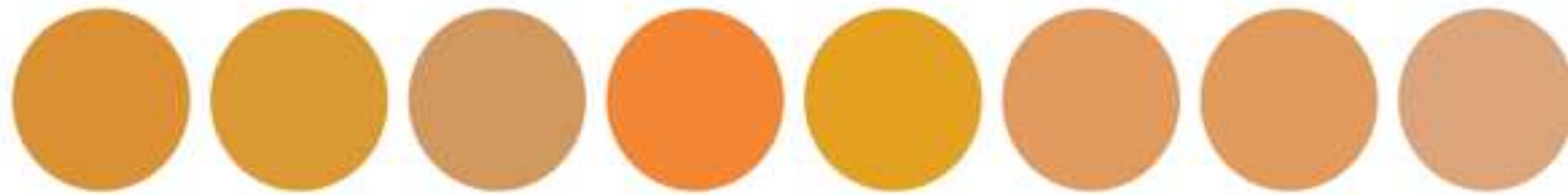
Choose one of the colour- rows (on the following page) and collect objects in nature with these colour shades. Try to find one from each shade. When you have collected the different shades, try to make a rainbow or a piece of art where the colours flow over in each other.

You can try to do this in the style of artist Andy Goldsworthy. He made some amazing pieces of art only using the objects and colours of nature.



Andy Goldsworthy made some amazing pieces of art only using the colours of nature

#15 Activity



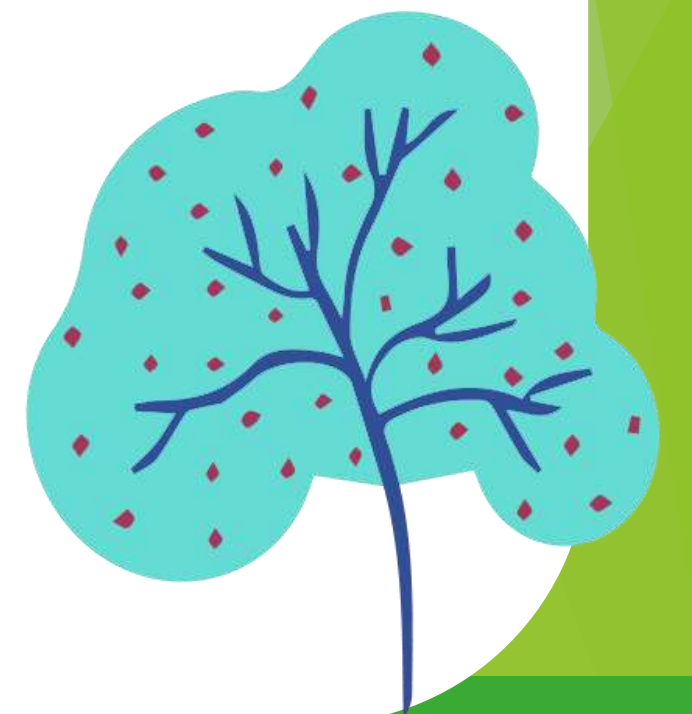
The colour-rows to use in this exercise

#15 Reflection

Try to answer the questions below on your own, then share with the group.

Choose one of the colours you collected.

- Is this a pleasant colour to you?
- What are the memories, people and things you associate with the different colours you collected?
- Create a list of all things that come to your mind when you see that color.
- Is there a colour that is not as pleasant to you?



#15 Take it a step further

Do you want to do more with this lesson? Take it a step further and get to action!

One step

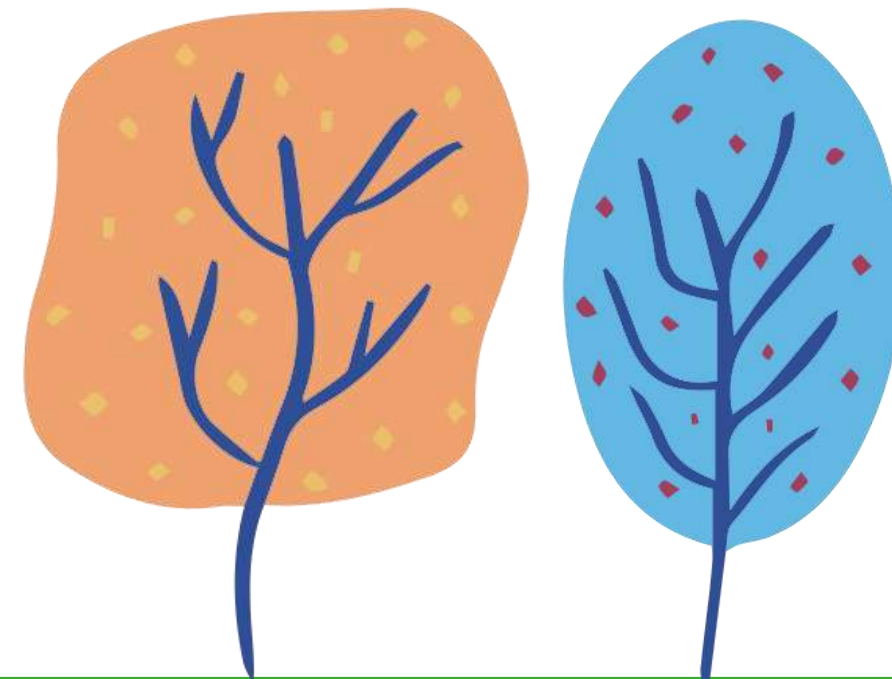
Look up more art of the artist Andy Goldsworthy when in class/ at home. Choose one of his art pieces and present it in class. You can do this alone or in groups, and choose how you present it to the others.

Two steps

Are there possibilities to build a big natural art work somewhere on the schoolyard?

Make a plan of what this should be and how this would look. Find something to contribute in the art piece for all classes of the school.

See what nature makes of it as time goes by.



#15 References and further inspiration

Sources used for this lesson:

Picture 1. Andy Goldsworthy via Bored Panda,
https://www.boredpanda.com/land-art-andy-goldsworthy/?utm_source=ecosia&utm_medium=referral&utm_campaign=organic

Picture 2. Clearing house

Sources used in this lesson:

Cambridge University Botanical Gardens

