European Commission

NATURE-BASED SOLUTIONS LEARNING SCENARIO

School Garden, Street Garden

Research and Innovation

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School Garden, Street Garden

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ABSTRACT

Green areas are increasingly scarce in cities and in schools and, in some cities, there are many abandoned green spaces and parks. These could become places of environmental education, biodiversity, and healthy recreation for people, improving cities' ecosystems.

The aim of this activity is to carry out a project with students that will connect uncultivated existent green areas, and external spaces of the school, with green cycling paths and walking tracks. The Pathways already exists, but they need to be greener. In order to succeed, we should connect the school to a wider network, including city councils and the private sector, and involving the civil population (i.e.: with the online forms/survey students will share on social media, and by making this area accessible to the neighbourhood and to the people outside the school).

Students will develop ideas which will be presented to local administrative authorities and NGOs, with an emphasis on studying existing plants, the local ecosystems, and designing spaces suitable for all age groups. In their green spaces, the students can spend some leisure time even in the afternoon. Moreover, their gardens would be a safe space for the neighbourhood's children and elderly and would promote people's health. Finally, senior citizens could collaborate by monitoring the green spaces and ensure the benefits that green spaces can provide while ensuring their safety.

Keywords

Biodiversity, environmental education, air pollution, public health, nature-based solutions, STEAM

1. Introduction

> *"Nature-based solutions (NBS) are solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes, and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services."*
> *https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en*

To use this Learning Scenario more effectively, teachers are encouraged to:

- Check out the list of recent EU publications on Nature-Based solutions
- Read about Nature-based solutions: Transforming cities, enhancing well-being (also available as a PDF)
- Contact local NBS practitioners or scientists working in their area (they can be found through Oppla).
- Use the "Ask Oppla" service to request help in case of any technical/scientific question on NBS.

2. Overview

Overview	
Subject	Agronomy, Statistics, Biology, Physics, ICT, Languages, Restoring degraded ecosystems, Climate mitigation, Climate adaptation and biodiversity, Quality of life, Health, Social cohesion
NBS topic	Public health, wellbeing, and air quality.

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<tr><td>Offline teaching material</td><td colspan="2">Camera, tape measure, dichotomous cards, sketchbooks, pencil and colour pens, AutoCad and photoshop, Smartphone APP, Compass</td></tr>
<tr><td>NBS resources used</td><td colspan="2"><table>
<tr><td>Oppla is a platform recognised by the European Commission, which brings together European experiences on ecosystem services and nature-based solutions. Oppla shares good practice, case studies and news.</td><td>https://oppla.eu/</td></tr>
<tr><td>In this page you can search for NBS case studies (good practices) from all over the world. The search can be done by writing a term, selecting scales or NBS types, selecting on the map.</td><td>https://oppla.eu/case-study-finder</td></tr>
</table></td></tr>
</table>

[1] For a younger students possible adaptation of this LS please see Annex 14.

Overview		
	Eco District Freiburg Vauban – Green city – Conversion of Old Military Bases	https://oppla.eu/casestudy/19561
	Video: Greenhouse Antwerp - Timelapse Buitenwerken Construction of a vertical garden in Anversa.	https://www.youtube.com/watch?v=8ygF_gdkr5g&feature=emb_logo
	Redevelopment project of the Artemide Lagoon. The project offers indications for the completion of a protected region and proposes specific projects and actions for scientific monitoring, ecological rehabilitation, regeneration and promotion.	https://naturvation.eu/nbs/athens/artemis-lagoon
	Ask Oppla – crowdfunding request service, help finding information on nature-based solutions. Answers are provided by members of the Oppla community.	https://oppla.eu/ask-oppla
	Planting and renovating urban trees Examples of urban green renewal, this NBS offers shady places and improves the user's wellbeing and connection with nature.	https://www.urbangreenup.eu/solutions/planting-and-renewal-urban-trees.kl
	Examples of green pedestrian and cycle paths seen as part of the green networks in the city. They are routes that offer recreational, public health and wellness opportunities, as well as transport links, providing a resource for outdoor education.	https://www.urbangreenup.eu/solutions/cycle-and-pedestrian-green-route.kl
	NATURVATION involves 14 institutions across Europe working in different fields such as urban development, studies on innovation, geography, ecology, environmental assessment, and economics. They evaluate the tools needed to realise the potential of nature-based solutions to achieve urban sustainability goals.	https://naturvation.eu/home
	URBAN GreenUP – New strategy for re-naturalising cities through nature-based solutions	https://www.youtube.com/watch?v=gMoiY_Yvc2M&feature=youtu.be
	Inspiration examples and critical thinking: Re-Green: Ecoculture Center – Green means to take responsibility: all the Rs. re-use, re-cycle, reduce, repair, re-think our actions, re-write the rules, re-view, re-model, re-design, re-invent.	https://re-green.gr/
	Seeing other resources of nature and green areas at EU. Clever Cities EU: aims to regenerate cities all over EU with Nature.	https://clevercities.eu/

3. Integration into the curriculum

This is an interdisciplinary scenario that according to the program of the Italian secondary schools of the second cycle (high school) tries to achieve the following objectives:

STEAM area:

- Mathematics: hints of statistics on green and uncultivated spaces changing over time, and analysis of the population survey (building a survey and analysing and interpreting data).
- Computer science: use of apps and elements of computational thinking.
- Science/Chemistry and Biology: characteristics and recognition of plants, study of the microclimate, ecosystem.
- Arts: draw a project proposal with Autocad and Photoshop

Linguistic area

- Geo-history area: read a geographical map – Urbanisation – research and description, with the aid of Google Maps, of green spaces, uncultivated areas in the city and the evolution of undeveloped spaces over the years, building a map of existing gardens, tree-lined avenues and green spaces.
- Human Sciences Area: the relationships between green spaces and the benefits to society.
- Italian language: L1 – learning storytelling, how to create relationships and sharing contents in a specific language.
- English language: L2 knowing how to search for documents and experiences in the original language (English).

4. Aim of the lesson

At the end of the lesson students will be able to:

- Improve their skills in the STEAM area.
- Analyse, plan and share the implementation of a practical case.
- Plan in first person (in groups) by collaborating with citizens, voluntary associations, and politicians.
- Understand the relationship between green spaces, the city's wellbeing and the person's physical and psychological health.
- Use computers, smartphones, and equipment consciously.

5. Outcome of the lesson

The purpose is to:

- Promote correct information and introduce NBS.
- Induce conscious and participatory behaviour and planning.
- Promote knowledge and awareness and respect for green spaces.
- Induce virtuous behaviour and respect for one's surroundings.

6. Trends

- Project-based Learning
- Outdoor Education

- Lifelong Learning
- Collaborative Learning
- STEAM learning
- Flipped Classroom
- Game Based Learning and Gamification
- Open Source Learning
- Mobile Learning
- Social Media
- Augmented Reality
- Visual search and learning
- BYOD

7. 21st century skills

- Literary literacy: ability to read, understand and use specific language in the context of study.
- Scientific literacy: ability to use knowledge and scientific principles to understand an individual's environment and make assumptions.
- ICT literacy: ability to use and create content for technology, to find and share information, answer questions, and interact with other people and with computer programmes.
- Cultural and civic literacy: ability to understand, appreciate, analyse, and apply knowledge of the humanities.
- Critical thinking/Problem-solving: ability to identify and ponder upon situations, ideas, and information to formulate answers and solutions.
- Creativity: ability to imagine and design new and innovative ways of tackling problems, responding to requests through the synthesis and application of knowledge
- Communication: ability to listen, understand and contextualise information through verbal, non-verbal, written, and visual signs.
- Collaboration: ability to work in a team to achieve a common goal, with the ability to prevent and manage conflicts.
- Curiosity: desire to ask questions, demonstrating an open mind
- Initiative: desire to take on new tasks and objectives
- Perseverance: ability to maintain interest in achieving a goal
- Flexibility: ability to change plans, methods, opinions, and goals in light of new information
- Leadership: ability to direct, guide and inspire others to achieve a common goal
- Social and cultural awareness: ability to interact with other people in a socially and ethically appropriate way.

8. Activities

Name of activity	Procedure	Time
First phase		
Start (evaluate the project idea together)	The first activity is to introduce and create the **School Class Project Group** with the role of coordinating and monitoring all actions planned for the students. The monitoring areas consists of each class adopting/choosing a part of the abandoned city areas, such as: tree-lined avenues or undeveloped natural spaces to be worked on. The flipped classroom method will be used in this session. The following material will be used to structure content for both teacher and students: • https://www.urbangreenup.eu/solutions/planting-and-renewal-urban-trees.kl • https://www.urbangreenup.eu/solutions/cycle-and-pedestrian-green-route.kl • https://oppla.eu/ask-oppla • Annex 10 – Flipped Classroom For homework watch videos at home. • Greenhouse Antwerp - Timelaps Buitenwerken - https://youtu.be/8ygF_gdkr5g • Planting 100,000 trees - https://youtu.be/qK8CV8z1YAk • Benefits of urban trees - https://youtu.be/iCy_m-u0VEM	20’
Planning: Step by Step	Each class involved should do: 1. **Analysis of the city in terms of how green it is** ‘(environment, research of **historical green areas**, **uncultivated spaces and school spaces** to be transformed into green islands). Each class chooses the space to study, using this tutorial: https://www.urbangreenup.eu/solutions/planting-and-renewal-urban-trees.kl 2. Online map (Bing or Google) to look at the city map and choose the spaces to study. 3. The teacher moderates the debate between three groups. For debate cards, see Annex 1 the sheet to use during the “Debate” and the rules to be followed. 4. Teacher present slides on Annex 13 about Public Health, Wellbeing and Air Quality, discuss with students and present facts 5. Then the students carry out a research in their environment based on Annex 2 content.	40’
Monitoring	Students will create a survey aimed at the school population and at city inhabitants. They will listen to their opinions and ideas to improve the green spaces of the city and will be invited to collaborate in the design stages. See Annex 3 for content: the suggestion is for students to create a Google form (containing the questions from the Annex 3) and share in their social media to get as much answers as possible.	30

Name of activity	Procedure	Time
Context analysis	Analysis of the **resources and services** to be connected to the **green areas network.** It is important to identify the main elements of socio-cultural aggregation in the town and to provide fundamental services for creating the "networking" of the "**Green Web**" (for example: network schools, municipality departments, services, pharmacies, grocery stores, churches, libraries and gyms). This analysis will be useful for building cycling paths or pedestrian paths connecting the various green areas of the town, including school open spaces (schoolyards, school gardens). Tool: Google Drive (Google Sheets and Mind Map) Method: Flipped classroom – See Annex 10	30
Second Phase		
Training	To design the proposed green spaces pupils must know their territory from a scientific point of view (such as ecology, ecosystems, plants systematics, plants, specificities, and climate change). This class will involve the following activities in the order provided: 1. First teacher presents a fact or curiosity to spark students' interest on the subject. Example: Annex 12 – Bamboo Bloom Curiosity 2. Then, to brainstorm and assess how much students know, the Bingo Game see Annex 4. Playing this game, the teacher will be able to decide on the level of difficulty of the following activities. The teacher should conclude that based on how many words the students know from the Bingo. 3. The following activity will allow students to have fun and learn about botany interactively – in Annex 5 you can see the Quizzlet or the Card Games. Teacher should choose which of the options is more suitable for their class – both have the same content the first is online and the second offline. (This could also be an activity assigned to do at home) 4. Then the teacher will evaluate what students have already learned through a Kahoot! See Annex 7, Kahoot: Kingdom of Plants. 5. Following, the teacher will present the different apps and tools that students will use to learn about the plants in their gardens and develop an in-depth study about them – see Annex 6. After being aware of the tools they should use, students should go visit school garden or the area they would like to make "greener". 6. An important tool to also be used, when students do not have access to a real lab is the GoLab. This allows them to see through a virtual microscope all the parts of the plants - see Annex 9. 7. After seeing the space, they will transform and knowing well the plants they would like to plant. Teacher should show the video on Annex 11. This material helps explaining specificities of each zone and the danger of putting an alien species where it does not belong.	120'

Name of activity	Procedure	Time
	8. Finally, at the end of the lesson, another Kahoot: that assesses for a second time what students have learned. See Annex 8 Kahoot: Plants and Public Health. This phase includes environmental education courses, awareness raising activities, and field trips. In the case of Italy, the activities could be carried out in collaboration with the educators of the CEAS Porto Conte, and the local environmental and the city natural association Legambiente and the University of Sassari (Faculty of Science and Agriculture). An additional recommendation would be for the school to take the opportunity to collaborate with an NBS expert. For example, by inviting local scientists or practitioners of NBS to dialogue with students on their experience, expertise, advices, and best practices for NBS implementation. Students can be inspired by these speakers for the effective and efficient planning of their NBS. An optimal tool to find this type of professionals is the Oppla.eu platform, specifically the Ask Oppla Service.	
Planning	This part of the process will involve the reflection, planning and involvement of civil society. The students must consider the following: Green spaces require specific characteristics that the students must consider in the design phase: • To encourage outdoor activities, to increase social relationships. • To encourage movement as a healthy habit Structures such as playground equipment, benches and fences must be: 1. Suitable for the environment to be created (e.g. school garden) 2. Made with environment-friendly materials (recycled and re-used materials 3. Have multi-purpose spaces suitable not only for children but also for teenagers (to avoid vandalism) 4. Accessible for strollers, prams, wheelchairs 5. Be an environment that encourages teenagers getting together for skateboarding or building a skating area. 6. Meet the needs of the community. All the ideas must be put into practice to translate the needs arising from the initial survey with the town inhabitants, specifically and effectively. Students should also take into account barriers to NBS implementation and how to overcome them, as illustrated by real-life examples in the European Union Publication *Public procurement of nature-based solutions.* Based on the survey, they should come up the plan to follow and how to implement. Afterwards they will express their ideas to the teacher and other colleagues	60’

Name of activity	Procedure	Time
Third Phase		
Operative Phase	The pupils draw the position of the green areas and the connecting networks (cycle paths and pedestrian paths), including the most suitable plants and furnishings (benches and playground equipment). Tools: AutoCAD, Photoshop, Canva: https://www.canva.com/	120′
Dissemination	The fourth phase aims to publicise and improve the experience gained and to transmit its contents, methodologies, processes, results and to spread good practices at the local level, for example via conferences, social networks and TV. In the town where this LS was created, there is an annual Rally which is a major source of pollution. One of student's suggestion was to highlight to the town authorities that by creating more green areas in the city and supporting the students project, in the future, they would be able to transform the Rally into a "Rally 0 emissions". The impact of the Rally on air quality and pollution could be compensated by having green areas to block/filter the emission. During the event, the Municipality of Alghero, environmental NGOs and universities are invited to raise awareness of local strategies to transform abandoned urban areas into "green islands".	60′

Annex 1: Debate

School garden-Street garden
Debate

Divide students into three student teams:

1. The team that defends and advocates the construction of vertical garden

2. The team that defends and advocates the construction of a network of "green islands – horizontal garden" connected with cycle and pedestrian paths

3. The audience should be around 3 students who are neutral, and evaluating the debate, asking questions, and helping in the decision-making process.

Before the debate, and at home, students should Watch videos and read materials about both Vertical and Horizontal garden. That way, they come to the debate prepared with arguments and knowledge on what would be more suitable to their school and to their environment specificities.

1. Vertical Garden	2. "Green Islands – Horizontal Garden" connected with cycle and pedestrian paths

3. Audience – three neutral students

Discussion and Debate Result
Here the results of the debate should be noted down, preferably, by the "audience" students. In the case of this LS what was decided was "Green islands – Horizontal Garden" connected with cycle and pedestrian paths. The students pointed out that they should not use as much water as a vertical garden would require. They also realised they had the space and a good plan to connect the Green Islands.

Annex 2: Survey 1 Public Health, Wellbeing & Air Quality

To see the form created for this check this link. Bellow you have the transcribed questions to do your own questionnaire.

Questionnaire for Students

Analysis of the city, research of historical green areas, uncultivated spaces, and school; spaces to be transformed into green islands.

*Mandatory to be answered

1. Look for city's green areas from 1800 to 1900*

2. Look for the city's green areas from 1900 to 2000*

3. Look for the city's green areas from 2000 until today*

4. Analyse the data, in the last few years there has been
    a. An increase
    b. A decrease

Annex 3: Survey 2 Public Health, Wellbeing & Air Quality

Questionnaire for community

Increasing tree cover and improving the management of urban forests can protect public health from air pollutants and reduce urban heat. The US Environmental Protection Agency has found that green roof temperatures can be 30–40°F (16-22°C) lower than those of conventional roofs and can reduce city-wide ambient temperatures by as much as 5°F (2.8°C)

1) How can pollution be reduced in the city? *Choose all that apply*

- Increasing three cover
- Building other gardens
- Building urban forest
- Other_____

2) Would you like to collaborate with us students?

- *Yes*
- *No*
- *Maybe*

3) Do you think the city air is polluted? *

- *Yes*
- *No*
- *A bit*

4) Would you like to give an idea on how the air quality in the city can be improved?

Annex 4: Bingo Game

School Garden-Street Garden

Bingo

1) Ask to each of your fellow students if they use or know the definition of the following words
2) Fill the boxes with the name of the students that know the words definitions
3) In order to win, you need to fill all the boxes with the name of at least one of your fellow students.

achenetum	***allochthonous***	***neophyte***	***dicotyledon***
petiole	***edible***	***samara***	***stigma***
angiosperm	***taproot***	***Mediterranean bush***	***rhizome***
taproot root	***Monocotyledon***	***gymnosperm***	***canescent***
Petal	***tepal***	***sepal***	***whorl***

Annex 5: Quizzlet or Card Game

For this activity, you can choose between the Quizzlet or the Card Game. This activity is all about linking the term to meaning. First you will see the content of Quizzlet in English. Following you can also find bellow the Quizzlet content but in 'cards' to be printed, distributed to students that will need to match term with meaning.

To access the Quizzlet in Italian, follow the link: https://quizlet.com/it/477324640/gamification-vegetal-app-plants-flash-cards/?x=1qqt

To create your own Quizzlet, see the answers and questions bellow:

1. Water, organic molecules, and mineral salts: The three components of which plants are made.

2. Brown algae, red algae, green algae, bryophytes, pteridophytes, gymnosperms and angiosperms: The phyla in which the plants are divided.

3. Alternation of generation: The characteristic of the life cycles of all terrestrial plants

4. Androceo: Verticillo formed by stamens.

5. Calice: Verticillo formed by sepals.

6.Calice, corolla, androceo and gynaeceum: The four verticils of the flower.

7. Carpelli: Modified leaves that form the ovary of the angiosperms.

8. Cicadine: Gimnosperms present in tropical regions and arid areas.

9. Cicadines, ginkgophytes, gnetophytes and conifers: Four groups into which gymnosperms are divided.

10. Cones: Structures containing seeds in gymnosperms.

11. Corm: Body of vascular plants.

12. Cormophytes: Plants in which it is possible to distinguish well-diversified systems.

13. Corolla: Verticillo formed by petals.

14. Corolla dialipetala: Type of corolla composed of free petals, freely inserted in the receptacle.

15. Corolla gamopetala: Type of corolla in which the petals are welded to form a single floral piece.

16. Waxy cuticle: Organ of the leaf used to limit water losses.

17. Dicotyledons: Class of angiosperms which include birch, oak, beech, cabbage ...

18. Dicotyledons and monocotyledons: Classes of angiosperms.

19. Dioecious: Plants that possess only male or female flowers only.

20. Anemocora dissemination: Dissemination by the wind.

21. Zoocora dissemination: Dissemination by animals 22. Epidermis: Leaf surface.

23. Horsetail: Type of pteridophytes without leaves and stems green.

24. Horsetails, lycopods and ferns: Groups in which the pteridophytes are divided.

25. Ferns: Type of pteridophytes with leaves generally enlarged, often without a real stem.

26. Filament and anthers: Parts into which the androceum is divided.

27. Phloem: Vessels used for the transport of photosynthesis products (elaborated sap).

28. Leaves: Part of the corm used for carrying out photosynthesis.

29. Fronds: The leaves of the ferns.

30. Stem: Part of the corm used as support and transport functions.

31. Gametes: Products in plants by mitosis.

32. Gametophytes: Haploid multicellular individuals.

33. Gimnosperms and angiosperms: The phyla that are part of the spermatophytes.

34. Gynaeceum (or pistil): Verticillo formed by ovary, stylus, and stigma.

35. Ginkgofite: high-stemmed gnomosperms with unmistakable leaves for their lobed shape.

36. Gnetophites: Gimnosperms characterised by a protection around the seeds, which seem almost enclosed in a fruit.

37. Imperfect: Flower that has only the androceum and not the gynaeceum or vice versa.

38. Anemogamous pollination: Type of pollination performed by the wind.

39. Artificial pollination: Type of pollination carried out by man.

40. Chirotterogama pollination: Type of pollination carried out by bats.

41. Entomogamous pollination: Type of pollination carried out by insects.

42. Hydrogam pollination: Type of pollination carried out by water.

43. Zoogamous pollination: Type of pollination performed by animals in general.

44. Leaf foil: Constituent of the leaves that goes to insert on the stem through the petiole.

45. Lycopods: Type of pteridophytes with narrow and long or squamiform leaves.

46. Mesophyll: The two zones of photosynthetic fabric of the leaves.

47. Monocotyledons: Class of the angiosperms of which orchids are part.

48. Monoecotyledons: Plants that have both male and female flowers.

49. Ribs: Nets formed from vascular tissue.

50. Perfect: Flower that has both the androeum and the gynaeceum.

51. Perianth: External portion of the flower made up of corolla and calyx.

52. Perigonium: Floral envelope made up of undifferentiated petals and sepals.

53. Pinecones: Female cones.

54. Pollen: Used to transfer the cells that give rise to the male gametes to the female parts.

55. Pteridophytes: Phyla of plants without flowers that reproduce via spores.

56. Pteridophytes, gymnosperms and angiosperms: Phyla of vascular plants.

57. Roots: Part of the corm used for the absorption of water and mineral salts from the subsoil.

58. Roots, stem and leaves: Parts into which the corm is divided.

59. Spermatophytes: Plants that reproduce thanks to seeds.

60. Sporangi: Organs used for the production of spores in pteridophytes.

61. Spores: Produced in plants by meiosis.

62. Sporophytes: Diploid multicellular individuals.

63. Stomas: Pores surrounded by a pair of specialised cells called guard cells.

64. Strobili: Male cones.

65. Tallophytes: Plants without specialised structures such as roots, stem, and leaves.

66. Integument: Woody seed coating.

67. Tepals: Name attributed to the petals that cannot be distinguished from the 68 sepals. Pollen tube: Subtle extension.

68. Pollen tube: Subtle extension emitted by the pollen grain**.**

69. Verticillo: Portion of flower used for the same function**.**

70. Vessillary (attract pollinating animals): The main function of the corolla.

71. Xylem: Vessels used for the transport of water and minerals (raw sap)**.**

72. Xylem and phloem: The systems of vessels of tracheophytes.

Cards to be printed.

Water, organic molecules and mineral salts
The three plant components
Brown algae, red algae, green algae, bryophytes, pteridophytes, gymnosperms and angiosperms
The phyla into which vegetables are divided
Dicotyledons and monocotyledons

The angiosperms categories
Class of angiosperms of which birch, oak, beech, cabbage are part...
Monocots
Class of angiosperms of which birch orchids
Plants without specialised structures such as roots, stem and leaves

Thallophytes
Cormophytes
Plants in which it is possible to distinguish well diversified systems
Spermatophytes
Plants that reproduce thanks to the seeds Gymnosperms and angiosperms

Are part of the spermatophytes
Alternation of generation
The characteristic of the life cycles of all terrestrial plants
The phyla in which gametes are produced in plants by mitosis
Spore

Produced in plants by meiosis
Sporophytes
Diploid multicellular individuals
Gametophytes
Aploid multicellular individuals

Roots, stem and leaves
Parts into which the corm is divided
Roots
Part of the corm used for the absorption of water and mineral salts from the subsoil
Stem

Part of the corm used for support and transport functions
Leaves
Part of the corm used for photosynthesis
Xylem and phloem of tracheophytes
Xylem

Vessel systems
Vessels used for the transport of water and minerals (raw sap)
Phloem
Photosynthesis products

Vessels used for (processed lymph)
Pteridophytes, gymnosperms and angiosperms
Phyla of vascular plants
Pteridophytes
Phyla of flowerless plants that reproduce via spores

Sporangia
Organs that produce spores in pteridophytes
Horsetails, lycopods and ferns
Groups in which pteridophytes are divided
Equisetum (horsetail)

Type of pteridophytes without leaves and with green stems
Lycopodium
Type of pteridophytes with narrow, long or scaly leaves
Ferns
Pteridophytes with generally enlarged leaves, often without a real stem

Type of Fronds
The ferns leaves
Modified leaves that are the angiosperms
Ovary
Carpels

Pollen
Structure used to transfer the cells that originate male gametes on female reproductive organ.
Cones
Structures containing seeds in gymnosperms
Pinecones

Female cones
Male cones
Strobili
Tegument
Woody coating of the seed

Cycads, ginkgophytes, gnetophyta and conifers
Four groups into which gymnosperms are divided
Cycads
Gimnosperms found in tropical regions and arid areas

Ginkgophytes
High trunk gymnosperms with unmistakable lobed leaves
Gnetophyta
Characterised by a particular protection around the seeds, which seem almost enclosed in a fruit
Whorl

Gymnosperms Parts of the flower with the same task
Chalice, corolla, androecium and gynaeceum
The four whorls of the flower
Chalice
Corolla

Verticil formed by sepals
Androecium
Verticil formed by stamens gynaeceum (or pistil)
Verticil formed by ovary, stylus and stigma

External portion of the flower composed of corolla and calyx
Perianth
Perigonium
Floral envelope composed by undifferentiated petals and sepals
Tepals

Name of the petals that are not distinguished from sepals
Vexillary (attract pollinating animals)
The main function of the corolla
gamopetalous Corolla
Type of corolla in which the petals are welded to form a single floral piece

dialypetalous Corolla
Kind of corolla composed by free petals, freely inserted into the receptacle
Filament and anther
Parts into which the android is divided
Entomogamous pollination

Type of pollination performed by insects
bat Pollination (chiropterophily)
Type of pollination performed by bats
Zoogamous pollination
Type of pollination performed by animals in general

Anemophily pollination
Type of pollination performed by the wind
Hydrophily pollination
Type of pollination performed by water
Artificial pollination

Type of pollination performed by humans
Perfect
Flower that has both the androecium and the gynaeceum
Imperfect
Flower that has only the androecium and not the gynaeceum or vice versa

Monoecious
Plants that have both male and female flowers
Dioecious
Plants that have only male or female flowers

Leaf blade
The broad portion of a leaf as distinct from the petiole
Mesophyll
The two areas of photosynthetic fabric of the leaves
Ribs of the leaves

Nets formed by vascular tissue
Epidermis
Leaf surface
Waxy cuticle
Leaf organ used to limit water losses

Stomata
Pores surrounded by a pair of specialised cells called guard cells
Pollen tube
Slender tubular outgrowth from a pollen grain
anemophilous Dissemination
Dissemination by the wind

Zoophilous dissemination
Dissemination by animals

Annex 6: Classifying Trees and Plants

Based on the Slides presentation (**NBS-CC-PPT-Plants-Apps-Resources**) teacher will present and show all the various sources students can use to familiarise themselves more plants, and discover everything they need to know about them before we start creating the green areas.

1st Plantifinder – Dryades : http://dryades.units.it/cercapiante/index.php

2nd Apps to Recognise Plants : PlantNet Identification**;** Picture This; Flora Incognita

3rd Acta Plantarum https://www.actaplantarum.org/ (In Italian – Specific to Italian Flora)

Annex 7: Kahoot - Kingdom of Plants

This is an English version, translated from Italian, which the teacher can use to create their own Kahoot! See the Original Kahoot for inspiration here: https://create.kahoot.it/share/the-kingdom-of-plants/8c66eea4-d409-4341-b345-a28e869ee9b6 and the Italian version of the Kahoot: https://create.kahoot.it/share/il-regno-delle-piante/4348210a-a368-4c44-be2d-90d7c4ef25c8

The Kingdom of Plants

The following Quiz has 18 Questions and the correct answer will be highlighted in green.

1 – An organism is said to be autotrophic if

- It is made up of many cells
- It can manufacture nourishment by itself
- It feeds on other living beings or their remains
- It has a life cycle

2 - **The ability to reproduce is only of**

- Animals and plants
- Only animals
- All living things
- Both of living and non-living things

3 - **Prokaryotic organisms are**

- All made up of cells
- Made by prokaryotic cells
- Both animal and vegetable
- Blue bacteria and algae

4 - **The plant cell is made from**

- Nucleus, cytoplasm, cell membrane, cell wall
- Golgi organ, centriole, nucleus
- Water, salts, proteins
- DNA, cytoplasm, mitochondria

5 - **What are the parts of a plant**

- Leaves, branches, buds
- Root, bark, change
- Root, stem, leaves
- Fruit flower, root

•

6 -**The roots of a plant have the function of**

- Support the plant

- Absorb nutrients
- Produce water
- Absorb water and minerals

•

7 - **Through chlorophyll photosynthesis plants transform**
- Glucose and oxygen in water and carbon dioxide
- Oxygen and carbon dioxide in water and glucose
- Carbon dioxide and water in glucose and oxygen
- Glucose and water in carbon dioxide and oxygen

8 - **The root hairs have the function of**
- Allow the root to go deep
- Increase the absorption surface
- Protect the surface of the root
- Produce cells in continuous division

9 - **From the outside towards the centre, in the root we find**
- The epidermis, the conducting vessels, the bark
- The bark, the epidermis, the conducting vessels
- The epidermis, the cortex, the conductive vessels
- The bark, the conducting vessels, the epidermis

10 -**The passage of gases between the inside and outside of the leaf occurs through**
- The stalk
- The stomata
- The cuticle
- The ribs

11 - **Breathing in plants**
- Is done during the day
- Is done at night
- It is carried out both day and night
- It does not happen, because it is replaced by photosynthesis

12 - **The thorns of the cacti derive from which transformation**
- Stem
- Leaves
- Flower
- Petiole

13 - The plant does photosynthesis

- only during the day
- only at night
- both day and night
- never

14 - **Chlorophyll is found**
- in stomata
- in chloroplasts
- in the mitochondria
- in the ribse

15 - **Flowers have the function of**
- beautify the plant
- perfume the environment
- playback
- none

16 - **The corolla is made by:**

- petals
- anther
- chalice
- tepals

17 - **The seed is obtained by transformation**

- of the leaf
- of the flower
- of the stem
- of the root

18 - **An organism is autotrophic if**

- It is made up of many cells
- It is capable of creating food
- It feeds on other living beings or their remains
- It has a life cycle

Annex 8: Kahoot – NBS – Plants and Public Health

This is an English version, translated from Italian, which the teacher can use to create their own Kahoot!

NBS - Plants and Public Health

See the Original Kahoot for inspiration here: https://create.kahoot.it/share/nbs-plants-and-public-health/8625d698-4330-402a-a72d-54365d106404

The following Quiz has 12 questions and the correct answer will be highlighted in green.

1 - **What does a plant start as?**
30 sec

- ☐ A bulb
- ☐ A tree
- ☐ A seed
- ☐ A weed

2 - **What part of the plant typically grows under the ground?**
30 sec

- ☐ Leaves
- ☐ Roots
- ☐ Flowers
- ☐ Stems

3 - **Which is not a part of a plant?**
30 sec

- ☐ A stem
- ☐ Roots
- ☐ Leaves
- ☐ Hands

4 - **What do the roots do?**
30 sec

- ☐ Absorb water
- ☐ Store food and nutrients
- ☐ Anchor the plant
- ☐ All of the above

5 - **What does the stem do?**
30 sec

- ☐ Holds the leaves/buds
- ☐ Transports (moves) fluids from the roots to the leaves/buds
- ☐ Stores nutrients
- ☐ All of the above

6 - **What do the leaves do?**
30 sec

- [ ] Change light energy into glucose (sugar) for plant food
- [ ] Provide shade for the ground
- [ ] Make plants look nice
- [ ] Use them to wave at other plants

7 - **Bonus! What is the name of the process where the leaves make food?**
30 sec

- [ ] Photogenic
- [ ] Photosynthesis
- [ ] Photographic
- [ ] Photocopy

8 - **What *don't* plants need?**
30 sec

- [ ] Water
- [ ] Candy
- [ ] Carbon dioxide (CO_2)
- [ ] Light

9 - **What do plants do for us?**
30 sec

- [ ] Creates air (Oxygen)
- [ ] Creates flowers or food
- [ ] Reduce pollution
- [ ] All of the above

10 - **Where *can't* you start growing plants?**
30 sec

- [ ] Inside in a pot/bag
- [ ] Outside in the dirt
- [ ] On the moon
- [ ] In a greenhouse

11 - **City gardens help human relationships**
20 sec

- [ ] True
- [ ] False

12 - **What are the green networks of a city**
20 sec

- [ ] Network of parks
- [ ] All private green spaces in a city
- [ ] Public network green spaces
- [ ] Free network green spaces cities

Annex 9: Go Lab –- Remote Microscope

For the students to be able to see all parts of the plant with a Microscope, they do not necessarily need to go to a Lab: GoLab has interesting tools to be used. To go to the Website you click on Remote Microscope.

To explain how to use and how this can be beneficial to the students, you can either go to the website and navigate with the students or use the Slides presentation prepared: **NBS-CC-PPT-GoLab-Presentation**

Annex 10: Flipped Classroom – Home Activities

To do the activity, students will need to follow different links and ideas. In the Slides presentation (**NBS-CC-PPT-Flipped-Classroom**) you will have a visual presentation with all links and QR codes to share with your students – while explaining how each of them will help with the activities.

Annex 11: Video L'Espeletia

To explain why not all plants could not go into our garden, and we should use the local species, the following video is a good example: https://www.youtube.com/watch?v=vg83khTvdzY

(Printscreen from YouTube Web page)

Thoughts to support teacher

Colombia is one of only four countries to have the unique páramo ecosystem and its most iconic plant is the frailejón, also known as the Espeletia. This succulent absorbs moisture in the air and releases the retained fresh water through its roots into the soil. While paramos occupy only 1.7 percent of Colombia's territory, it is responsible for more than 70 percent of the country's water supply and is the source of major river systems in Colombia, Venezuela, Ecuador, and northern Peru. The frailejón is also an endangered species.

We conclude that we need to know the plants before planting them…

How can we know them?

1) Observation (by dichotomous cards, lens, optical microscope, etc)
2) By using your smartphone, websites and APP for plants classification that were presented before on Annex 6.
3) By doing all the activities and researching before.

Annex 12: Curiosity – Bamboo Bloom

To spark student's curiosity, introduce your class with interesting facts, example:

Bamboo Bloom

Photo: Mogens Engelund -Attribution CC-BY SA (See License)

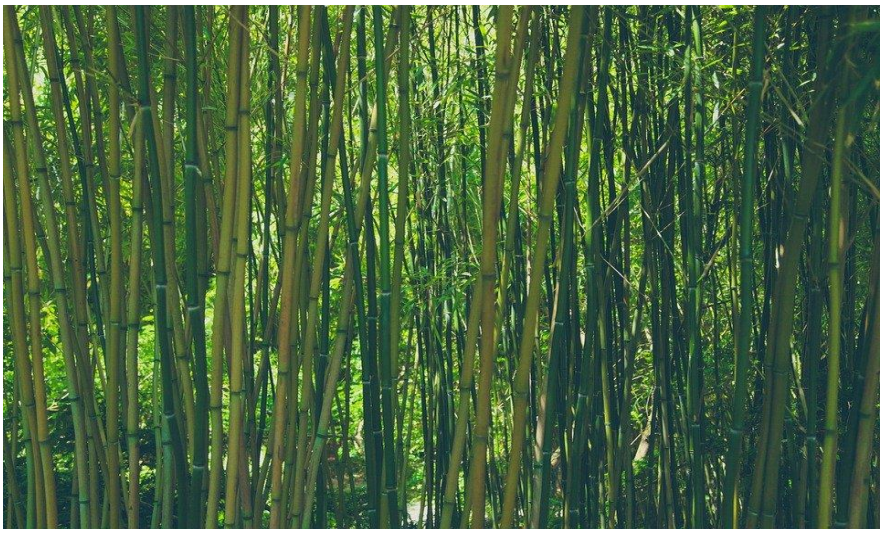

Image by Free-Photos (Pixabay License)

Did you know?

- Bamboo is the fastest-growing plant on Earth, with a speed of around 10 centimetres each day (visible to the naked eye)
- Flowering is a mystery; it is a slow process.
- Most bamboo plants bloom once every 60 years. Some only every 100/130 years.
- Plants from the same mother bloom all over the world at the same time, even if they are found in different places. Because they have the same genetic makeup as the mother plant.

Source: Amusing Planet - The Mysterious Phenomenon of Bamboo Flowering, by Kaushik Patowary

Annex 13: Public health, wellbeing, and air quality

In the following slides there is supporting visual material to present, generate discussion with students, hear their thoughts and present them facts. See the slides presentation in the document **NBS-CC-PPT-Public-health-wellbeing.** This will support a more engaging activity.

Annex 14: Adaptation to Kindergarten students

These activities can be done with children aged 2 to 6, to simplify the LS for their age group.

A) Activities for children

1 Adventure-Create plant structures – galleries, huts, doors, small shelters in order to stimulate the imagination.

2.Adopt a Cutting to which the name of the child or group must be inserted, using long branches of willow, rush or other plant to be planted on the ground so that they return to germinate every year.

3. The Wind exists – to create fantastic corners in which to tell the story of the garden enriched by children, corners where the wind moves the vegetation.

4. The small greenhouse – Every child or group of children plant a seed in a transparent pot and see it sprout, transform

5. Fantasy – Constructions with fantastic animal branches and garden products.

6. Open to the territory – Involvement of families, children and inhabitants of the neighbourhood, helping them to feel the school spaces as their own.

7. Laboratory of sensuous small flower beds.

8. My garden - simple gardens to take care of together, corners where the water flows for short stretches, differences in level of the ground.

B) The garden as a laboratory of the body, for fantasies, ideas, games, observation and discoveries.

Laboratory no.1: The earth

1. Take a clod of earth to be crushed.

2. Blow the dust on the grass or bushes, see what happens.

3.Take water coloured with natural dyes (food dyes) try to colour different clods and grains of earth.

4. Knead the earth, crush it between sheets of foil and observe the shapes that are obtained when the foil is removed. With the mixture of earth, you can create small bricks to dry in the sun and construct small houses.

Laboratory no.2: The water

You can build pools of water where children can observe the colour, the reflections of light, the leaves that float, animals that run, the shadows of objects or their bodies.

Laboratory no.3: Trees-Plants

Children in groups can draw a tree on a billboard and glue leaves and branches.

Observe the growth of the plants using the plastic cup with cotton and wheat seed or a bean.

Create a small vegetable garden in collaboration with the parents and inhabitants of the neighbourhood.

Laboratory no.4: Senses

The angle of smells and aromatic herbs,

Building flowerbeds, fragrant bushes, and fruit trees. Children are great observers, and love to collaborate with and discuss with each other.

When a child watches an adult or a companion who sows, waters, gathers, tastes, the child is learning the gestures, attitudes and experiences the same emotions.

THE CARDS

Page no.1

Path with wooden logs in horizontal position

Structure Material/logs from wood, cut city trees Mode of positioning to be placed on vegetable soil	Nest/Childhood Age > 2 years Nest 3 years Childhood How to use: Child walk a maximum of two children per route.

Path with wooden trunks in vertical position

STRUCTURE Material/logs from wood , cut city trees Mode of positioning to be placed on vegetable soil	Nest/Childhood Age > 2 years Nest 3 years Childhood How to use: Child play per trunk. We try to climb, whoever stays on the trunk for the longest time wins

Path on the hills

Structure material (s) Small bumps built into the ground mode of positioning 3 or 4 small nearby hills	Nest / Childhood Age > 2 years Nest 3 years Childhood How to use: A maximum of two children play per hill. Children must go up and down all the hills

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About the NBS project

The NBS project is initiated and funded by the European Commission Directorate-General for Research and Innovation and coordinated by PPMI, in collaboration with European Schoolnet (EUN). PPMI (www.ppmi.lt/en) is a leading European research and policy analysis centre, aiming to help public sector and civil society leaders from around the world, presenting evidence in a way that is simple, clear and ready to use. European Schoolnet (www.eun.org) is the network of 34 European Ministries of Education, based in Brussels. EUN aims to bring innovation in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers, researchers, and industry partners. Find out more about nature-based solutions: https://ec.europa.eu/research/environment/index.cfm?pg=nbs and all the NBS Learning Scenarios created in this project as well as the overall reports can be found at http://www.scientix.eu/pilots/nbs-project

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Green areas are increasingly scarce in cities and in schools and, in some cities, there are many abandoned green spaces and parks. These could become places of environmental education, biodiversity, and healthy recreation for people, improving cities' ecosystems.
The aim of this activity is to carry out a project with students that will connect uncultivated existent green areas, and external spaces of the school, with green cycling paths and walking tracks. The Pathways already exists, but they need to be greener. In order to succeed, we should connect the school to a wider network, including city councils and the private sector, and involving the civil population (i.e.: with the online forms/survey students will share on social media, and by making this area accessible to the neighbourhood and to the people outside the school).
Students will develop ideas which will be presented to local administrative authorities and NGOs, with an emphasis on studying existing plants, the local ecosystems, and designing spaces suitable for all age groups. In their green spaces, the students can spend some leisure time even in the afternoon. Moreover, their gardens would be a safe space for the neighbourhood's children and elderly and would promote people's health. Finally, senior citizens could collaborate by monitoring the green spaces and ensure the benefits that green spaces can provide while ensuring their safety.

Studies and reports

Publications Office
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