NBS EduWORLD

NATURE-BASED SOLUTIONS LEARNING SCENARIO

*All fields in this template are mandatory for submitting your learning scenario to the **"Nature-Based Solutions in Education Competition for Teachers 2023."** In case a field is not relevant to your learning scenario, please write N/A.*

Your learning scenario and any materials/resources included in it, should be in English.

Title

Water management in the context of NBS

Author(s)

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Abstract

We are witnessing ever-increasing problems related to human activities and climate change: droughts, floods, fires, water and air pollution... City dwellers are additionally exposed to the impacts of outdated urban infrastructure design. In this LS, students will be familiar with problems, but also with existing solutions which are nature based, specifically with the topic of water management.
They will conduct experiment to investigate if grey water can be reused for watering plants.

Keywords

water management, urban floods, wastewater and rainwater drainage, greywater reuse

Introduction (leave this section as it is)

"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."

*Source:**https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en***

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

- Check out the list of **recent EU publications on nature-based solutions**.
- Learn about the European Union's **GreenComp framework** for sustainability competences and how these can help students develop other skills
- Search for inspiration in **the Learning Scenarios** developed during the Integrating Nature-Based Solutions in Education (funded by the EC and coordinated by PPMI, in collaboration with EUN).
- Read about **Nature-based solutions: Transforming cities, enhancing well-being** (also available as a detailed PDF).
- Learn more about nature-based solutions by looking at NBS case studies in repositories, such as **NetworkNature**, **Oppla** and **Urban Nature Atlas**.
- Contact local NBS practitioners or scientists working in their area (they can be found through **Oppla**).
- Use the **"Ask Oppla"** and **NetworkNature Helpdesk** service to request help in case of any technical/scientific question on NBS.
- Read about the European Union's **European Green Deal** to understand the current EU strategy on climate change and COVID recovery
- Read the European Union's **Biodiversity Strategy 2030** to learn about the challenges Nature faces in Europe

Overview

Summary	
Subject	*Chemistry, biology, ecology*
Topic	*Indicate below which of the **twelve NBS societal challenges** your learning scenario addresses:* ☐ Air quality ☐ Biodiversity enhancement ☐ Climate resilience ☒ Green space management ☐ Health and well-being ☐ Knowledge building for sustainable urban transformation ☐ Land regeneration ☐ Natural and climate hazards ☐ New economic opportunities and green jobs ☐ Participatory planning and governance ☐ Social justice and social cohesion ☒ Water management
GreenComp Competences	**Area: Embodying sustainability values** ☒ Valuing sustainability ☐ Supporting fairness

Summary	
	☒ Promoting nature **Area: Embracing complexity in sustainability** ☐ Systems thinking ☐ Critical thinking ☒ Problem framing **Area: Envisioning sustainable futures** ☐ Futures literacy ☒ Adaptability ☒ Exploratory thinking **Area: Envisioning sustainable futures** ☐ Political agency ☒ Collective agency ☒ Individual agency
Age of students	*13-14*
Preparation time	*2 hours*
Teaching time	*3 hours for teaching and preparing experiment, time for plant growing (few weeks), 1 hour to present experimental data*
Online teaching material(s) used	Padlet, Sway NBS resouces (listed below)
Offline teaching material(s) used	*Paper, pencil, material for experiment listed in Annex 3.*
NBS resource(s) used	**GreenComp framework** **Oppla** *https://oppla.eu/product/26126* Rainwater harvesting & greywater recycling against climate change *https://unalab.eu/en/what-are-nbs* *https://www.youtube.com/watch?v=G4UCkKmRPAw&t=245s* *https://www.youtube.com/watch?v=WWI2l0LR1_8* *https://www.youtube.com/watch?v=K-e0YsbJCxE* *https://www.nature.scot/urban-grey-urban-green* CORDIS NBS: *https://cordis.europa.eu/article/id/421853-nature-based-solutions* INERREG CENTRAL EUROPE NBS *https://www.interreg-central.eu/* Other videos that can be used: *https://www.youtube.com/watch?v=fHSQPRK_hcc*

Summary	
	https://www.youtube.com/watch?v=Abg_hAJWXNk

License

Integration into the curriculum

NBS aim to tackle environmental and social challenges in every country. Specifically, the topic of water management is related to several subjects: chemistry, biology, physics, geography, ecology, engineering and civil education. Understanding and identifying the meaning of sustainable water management and developing actions that contribute to that management and recognition water pollution problems can be teach as integrated LS.

Aim of the lesson

Teach students about the concept of NBS and how to assess the value of the initiative and/or plant for their local environment and biosphere.

Provide students with information and raise awareness about the relevance and essential role of water management in an urban area for the environment, biodiversity, health and wellbeing of the local population, social justice, and urban planning.

Develop experimental skills related to NBS.

Outcome of the lesson

Students will be able to describe water management, how it used to be and how it is planned in modern urban area and advantages of modern urban water management. Students will think about other nature based solutions that they can apply in their environment.

Trends

Problem-Based Learning: students face problems to solve.

Collaborative Learning: a strong focus on group work.

Active Learning: students are actively engaged with the lessons through discussions, problem solving, experiments and other methods.

21st century skills

Collaboration: students will work in pairs and team

Critical thinking: students will discuss problems, share solutions

Content and language integrated learning (CLIL): We use a foreign language (English) as the medium of instruction, allowing this way the practice and improvement of both the second language and the immersion to STEAM and non-STEM subjects.

Creativity: students will create their own presentations, posters

ICT Literacy: students can practice and/or develop their ICT skills

STEM Strategy Criteria

Elements and criteria	How is this criterion addressed in the learning scenario
Instruction	
Personalization of learning	Students will be able to do some exercises in their own time and to choose homework exercise which they like the most.
Problem and project-based learning (PBL)	Students work on an open-ended question with no solution provided by the teacher.
Inquiry-Based Science Education (IBSE)	
Curriculum implementation	
Emphasis on STEM topics and competencies	STEM key competences and STEM topics are emphasized during the LS implementation.
Interdisciplinary instruction	We examine and implement a variety of activities in a wide spectrum of subjects, Chemistry as basic but in correlation with Biology, Physics, English
Contextualization of STEM teaching	Lessons are connected to real world experiences – water management, water cycle, water pollution, water purification, …
Assessment	
Continuous assessment	A formative evaluation is carried out, allowing a continuous improvement on the students' progress.
Personalized assessment	The pace of learning and the instructional approach are optimized for the needs of each student.
Professionalization of staff	
Highly qualified professionals	
Existence of supporting (pedagogical) staff	Supporting staff play an important role in ensuring students are learning in a safe and encouraging learning environment.
Professional development	Teachers have opportunities to enrol a variety of online courses. Also, professional literature and articles are available, online and in libraries.
School leadership and culture	
School leadership	
High level of cooperation among staff	

Elements and criteria	How is this criterion addressed in the learning scenario
Inclusive culture	
Connections	
With industry	
With parents/guardians	Students involve parents in some tasks and promote awareness of water management.
With other schools and/or educational platforms	
With universities and/or research centers	
With local communities	
School infrastructure	
Access to technology and equipment	For some exercises the teacher can use tablets, laptops, and smartphones with internet connection. However, it is possible to modify tasks for those, who don't have access to technology and/or equipment.
High quality instruction classroom materials	

Activities

Name of the activity	Procedure	Time
Lesson 1		
Introduction to NBS.	Since the students are not yet familiar with NBS, the teacher will introduce the topic to students, mainly what are NBS, what is its definition and what are the challenges of NBS, based on a reading in Annex 1 and video: https://unalab.eu/en/what-are-nbs (about 2 min)	10 min
Introduction to watermanagment	When students are acquainted with meaning of NBS, the teacher announce a specific topic: Water management, based on reading Annex 2 and video https://www.youtube.com/watch?v=K-e0YsbJCxE	5 min
Watching video, team work and presentation	Students are divided into 4 groups. They are watching video from OPPLA repository about water management Rainwater harvesting & greywater recycling against climate change https://www.youtube.com/watch?v=G4UCkKmRPAw (10 min). Each group defines 3 problems related to water management in cities in the past and present.	30 min

Name of the activity	Procedure	Time
Brainstorm	Students discus about problems they detected and possible solutions for urban water management problems. They have to find examples on internet (e.g. pictures like grey vs green urban spaces) and share it on Padlet.	15 min
Watching video	Students watch video from OPPLA repository about possible solutions applied in city: https://www.youtube.com/watch?v=WWI2l0LR1_8 (13 min) and discuss it.	20 min
Lesson 2		
Introduction to hand on activity	In previous lesson students learned that green surfaces in city can reduce flooding by absorbing rainwater and retain and slowly release water. Also, they learned that grey water, is considered wastewater by most people. However, it's beginning to be treated and used as fresh water (not drinkable) around the world in places dealing with growing populations. Students will explore if rain and grey water can be reused to water plants instead of being released into the sewage system. Materials and hand on activities are listed in Annex 3.	45 min
Hand on activity: Greywater for plants?	Students, divided into 3-4 groups, conduct experiment with different type of water. Make sure, that every group has divided tasks so every student can contribute. After finishing experimental part, students fill peer assessment rubric (Annex 4).	Few weeks
Presentation of results	Since experiment lasts few weeks, teacher will decide when it is suitable to present results. Results and conclusions can be presented in joint table on Padlet or in poster.	45 min
Formal assessment	At the end, formal assessment is carried out so student can assess their knowledge on the topic. Worksheet is in Annex 5. Students can express their opinion about the topic and if they are interested in theme, they can suggest another NBS topic for investigate (Padlet).	individual
Homework (for students who want to learn more)	Choose one NBS project from: https://cordis.europa.eu/article/id/421853-nature-based-solutions and create a short presentation in Sway app about it (problem, solution, advantages and disadvantages).	individual

Assessment

Peer assessment after performing experiment (Annex 4.) and formal assessment at the end of a lesson (Annex 5.)

Student feedback

On Padlet, students can express their opinion about the topic and if they are interested in theme, they can suggest another topic for investigate e.g. climate mitigation and adaptation, floods, drafts, fires, disaster risks, air quality, social justice, …

Teacher's remarks

LS can be easily adopted to online version.

About the NBS EduWORLD project

The "Nature-Based Solutions Education Network" (NBS EduWORLD) is an EC-funded Horizon Europe project (Grant Agreement No. 101060525) that aims at nurturing an NBS literate society, supporting a just transition to a sustainable future. For this, NBS EduWORLD will create an NBS community that facilitates synergies between NBS professionals and education providers and ensures free and easy access to NBS knowledge and resources for all. The project's Consortium comprises 16 partners from 13 European countries, all of whom visionary organizations and leading NBS / education stakeholders across Europe, who will work together in the creation of an NBS EduWORLD, a community that makes a difference.

Annex

Annex 1. The concept of NBS

The concept of nature-based solutions (NBS) emerges from other ideas such a protecting ecosystems or tackling environmental and climate challenges. NBS are designed to bring more nature and natural features and processes to cities, landscapes and seascapes while supporting economic growth, job creation and human wellbeing. The EU defines nature-based solutions to societal challenges as "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.

NBS can help tackling:

1. Climate mitigation and adaptation
2. Air quality
3. Water management
4. Disaster risk reduction
5. Green spaces and urban regeneration
6. Public health and wellbeing
7. Participatory planning and governance
8. Social justice and social cohesion
9. Economic opportunities and green jobs

Annex 2.

Water Resources Management (WRM) is the process of planning, developing, and managing water resources, in terms of both water quantity and quality, across all water uses. It includes the institutions, infrastructure, incentives, and information systems that support and guide water management.

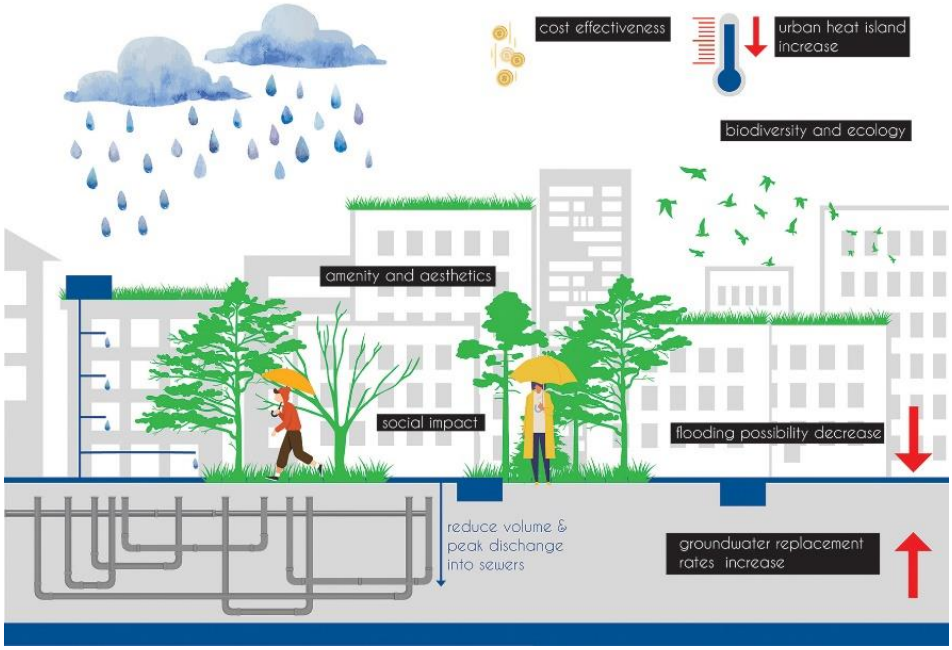
The City Water Circles - CWC project aims to help municipalities to reform outdated urban water infrastructure systems via applying a circular economy approach and nature-based solutions which offers many economic and environmental benefits.

Sustainability in urban water management is of utmost importance. The distribution of water should depend not only on the availability of the valuable natural resources but also on its efficient use. Water quality plays an equally significant role since if different water uses are taken into account could provide a more sustainable water distribution.

Examples of NBS for urban water management

Green vs grey urban spaces: https://www.nature.scot/urban-grey-urban-green

https://futurearchitectureplatform.org/projects/0affbb8b-4058-49c2-b98a-e880de3e73e2/



Annex 3.

Experiment: Rainwater or greywater for plants?

Problem: Can rainwater and greywater be used to water plants? Does the type of greywater determine whether or not a plant will grow? What is the general relationship between water type and plant growth?

Hypothesis: Student make their own hypothesis regarding problem questions.

Material:

- Greywater collected from different sources
- Rainwater
- Fresh, potable water
- Empty plastic water bottles
- Small pots for planting (depending on how many samples on greywater students will collect)
- Potting soil
- Pinto bean seeds
- Labeling tape
- Ruler

Procedure:

1. Collect greywater from different sources in labeled plastic bottles. This could be water you washed your hands in, water from washing dishes, bathtub water, or any other greywater source you can think of.
2. Collect rainwater.
3. Plant your seeds. Put 1-2 seeds in each pot with potting soil. Label your containers with the type of water you will water them with.
4. Water each plant with the same type of water each day. Be sure to have a control group that is watered with fresh water. Be sure to water each plant with the same amount of water, regardless of the type of water being used.
5. Measure the height of the plants once they begin to sprout. Record the date and height and measure daily. Data can be put in common table on Padlet so they can be compared on the end.
6. Compare which types of water help plants grow the best.

Table 1. Measuring the height of plants (for each water type)

Water type		
Date	**Height**	**Other observations (color of leafs, stains, stem strength, …)**

Observations: Do you notice any difference in color from one plant to the next? Do you notice any differences in strength or a plant's ability to stand upright?

Conclusion: Based on experimental data, students will confirm or deny their hypothesis.

Annex 4.

Rubric 1. Teamwork assessment

Statement	Yes/No
I know exactly what my tasks in this group are.	
When I faced difficulties, I looked for help both inside and outside of the group.	
Usually, I express my views and opinions clearly to my group.	
I helped my colleagues when I realized that they had problems, even without them asking me for help.	
I believe I would not be able to do a better job myself than what was achieved by my group.	

Annex 5. **Formal assessment**

Worksheet *(with possible answers)*

1. How would you describe, in your own words, what are nature based solutions.

Nature-based solutions are actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

2. What is the meaning of "urban heat island" and how it affects on human health?

"Urban heat islands" occur when cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. This effect increases energy costs (e.g., for air conditioning), air pollution levels, and heat-related illness and mortality.

3. Name at least 3 problem caused by traditional rainwater draining and sewage system.

Floods, draughts, low air quality, water shortage, higher temperature in cities, pollution of rivers, fish mortality…

4. What are solutions for urban water management offered by NBS?

Retention and evaporation of rainwater: constructed wetlands, raingardens, green roofs and balconies, infiltration trenches, reusing rain and greywater, …

5. True or false.

NBS are solutions for environmental problems supported by nature. T – F

NBS can not be implemented in existing urban areas. T – F

NBS for urban floods is to collect rainwater together with wastewater and drains into rivers. T – F

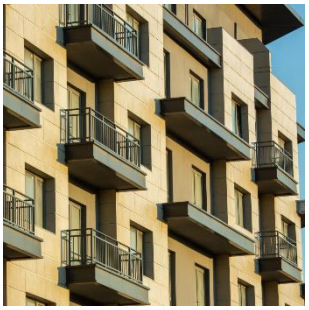
Green surfaces can absorb, retain and slowly release water so they are excellent NBS for water management. T - F

Plant with a high water retention potential are reeds and other wetland plants. T – F

Water management and urban heat island are not in any way connected. T – F

6. Which of two picture represents NBS:

A 

B 

A 

B