Norway grants
STÁTNÍ FOND ŽIVOTNÍHO PROSTŘEDÍ ČESKÉ REPUBLIKY
SEVER STŘEDISKO EKOLOGICKÉ VÝCHOVY

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Wet, Not Flooded

Abstract

In this minilesson, you will conduct experiments to explore the ability of humus to absorb and hold water like a sponge. Students will test how much water different soil samples can suck in and explore natural solutions for urban adaptation to climate change. Furthermore, students will use different natural materials in an attempt to hold as much water as possible in a model piece of land – a pile of sand/soil.

Unit type and duration

The experiments require 2 × 45 minutes.

Target group

Lower secondary programmes, upper secondary programmes.

Context and cross-curricular links

Above all, the minilesson integrates the following subjects: Biology; Physics; and Mathematics.

Goals and outputs

Goals:

- Students learn about natural phenomena linked to climate change adaptation.
- Students understand that natural phenomena and laws do not work in isolation, they are all interrelated, and therefore, the nature should be viewed as a whole, rather than a set of separate independent parts.

Outputs:

- Students recommend climate change adaptation measures suitable for the community.
- Students develop their analogical and critical thinking, argumentative and discussion skills.

Outline of the activities

Activity 1: Introducing the topic, brainstorming
Duration: 20 minutes
Location: classroom
Materials: sticky notes, writing supplies

Activity description:
Start by introducing students to the assignment. They will try out two experiments to learn about water retention in nature. With that knowledge, they will go explore their immediate surroundings and try to identify which places might use more water retention or a change in water management methods, especially during floods and heavy rain. It will be up to students to recommend and design a concrete measure to help keep those places safe during such climate events while staying soaked with enough water for any dry periods.

Now invite students to formulate their views on how water can be retained in an urban environment.

- Would a change in water management methods make a difference?
- What kind of change would help and how?

You can write their views on the whiteboard or give a few sticky notes to each student, inviting them to think about their answers individually and then share them with the group (by attaching the notes to the whiteboard).

Activity 2: Experiment – Holding water in the soil
Duration: 15–30 minutes
Location: in classroom or outdoors
Materials: Each student will need: a soil sample, a flower pot with openings, a piece of paper tissue, the bottom part of a plastic bottle, 0.5 l of water per sample, (a stopwatch), (a pen an paper for charting), internet access, Water Retention in Soil – teacher's PPT presentation with illustrative examples

- The soil sample should be at least 0.5 l in volume. Ideally, students bring their own samples to make the results more diverse and the experiment more intriguing. They should write down where the soil comes from – a brief description of the sampling site; IMPORTANT: the samples should be absolutely dry (taken several days before the experiment and dried in the sun or on a radiator).
- Place a piece of tissue on the bottom of each pot to cover the openings and prevent sand or fine soil from falling through.

- Use the bottom part of a plastic bottle/large jar to collect the water flowing out of the soil sample → it must fit the pot.

Activity description:
Ask students to pour water into their soil-filled pots. In this experiment, they are going to measure the amount of water flowing out, namely at different time intervals (e.g. every minute), and chart the data. Students will then compare one another's results. After completing the experiment, students can present their charted results.

Conclude the activity by opening a discussion, e.g. based on the following inspirations and questions:

- Were there any differences between your soil samples?
- What caused the differences?
- Imagine soil without humus and with humus in summer drought. When it rains or we irrigate the soil, which soil will keep the water longer available for plants? Which plants are more sensitive to drought and which ones less? How can we make sure our soil has the best ability to hold water?

Alternative questions:

- How would you improve soil quality in your own garden?
    — Compost, manure, legumes.
- What kind of measures would you implement to retain as much water in the soil as possible?
    — Mulching, less weeding, no bare ground or short grass.
- Which plants are vulnerable to drought and which ones are more drought-resistant?
    — Wetland plants, succulents.

You can use the PPT presentation for your discussion, either as it is or after adapting it to your needs.

Activity 3: Experiment – Holding water in the land
Duration: 45 minutes
Location: in classroom or outdoors
Materials: Each team will need: at least 2 l of sand or soil, 10 l at best; a large plastic or metal container (with volume markings) – only needed for indoor activity; sticks, twigs, stones, pebbles, leaves; 1 l of water; watering can – one for the entire class is enough; Water Retention in Soil teacher's PPT presentation

Activity description:
The activity can take place indoors or outdoors. In the classroom, students should bring two desks together to make enough room for their large container. However, the activity will be

much more comfortable outside, where no containers are needed. To conduct the experiment, prepare at least 2 l, ideally 10 l of sand (or soil) for the activity and the container for building your pile. Whenever possible, conduct your experiment outside, at a spot with available soil (e.g. dirt removed from a construction site), a sandbox, or simply a slope with bare ground. Only use your containers to measure the amount of water that was not retained. That should by no means prevent you from implementing the activity.

Form your pile in the container by slowly pouring the sand/soil to one spot. Your goal is to make sure that after irrigating, as much water as possible is held in the sand/soil and as little as possible flows out. You can avail yourselves of some materials such as sticks, twigs, stones, pebbles, leaves. When your pile is ready, pour onto it 0.5–1.0 l of water from the can, depending on its height. For indoor activity, it is recommended for each team to have the same amount and type of soil/sand to ensure comparable results. For a greater learning effect, pour water onto one pile at a time so that all students can observe how the different teams' strategies work out. This is especially recommended for the outdoor activity when students use no containers and cannot measure the runoff volume. During the experiment, you are going to measure how much water has flown into the container within 5 minutes.

This is followed by class presentations of the results. When using containers for indoor activity, record the volume of water runoff from your pile and present your results to the class. For both indoor and outdoor activity, the most successful team can explain their water retention strategy to others.
The presentations are followed by a discussion. Below is a set of inspiring ideas (again, using the Water Retention in Soil presentation is recommended during the discussion):

- Think about the relevance of different techniques and their functions in water retention. Some materials perform better in slowing down the flow of water (stones), other formations allow water to soak the soil (trenches, ponds, dams). What other factors play a role in how the land works? Try to include all the factors you have explored in previous science lessons.
- Compare contemporary agricultural land with one that holds water.
    - What is the role of vegetation in water retention?
      - roots prevent water runoff, work like a dam = infiltration
    - What other land functions do hedges perform?
      - slowing down the flow of water, breaking the wind, providing a habitat and food for animals
    - What do you think of agricultural land drainage? Why was it performed and what impacts does it have today?
      - draining water from wet fields to improve growing conditions for intensive agriculture based on heavy farm vehicles. These days, we often lack the water that is drained through those pipes, and the land suffers from drought.

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This is also because it is unable to soak the large amounts of water brought by rain. In an attempt to hold water in the land, some people have started decommissioning those drainage pipes and reconstructing natural water basins and streams on their land. There is a movement to depart from agricultural methods using heavy vehicles, which cause soil compaction and make the soil less permeable for water. Rainwater runs off and heavy rains take large amounts of soil away, making soil erosion a serious and persistent problem. Soil is not a renewable source: although it takes thousands of years for a few centimetres to form, we lose the soil in a matter of years.

- How can land be improved to hold more water and lose less water through evapotranspiration?
  - larger amounts of small water bodies and deregulated rivers, a spatially more diverse landscape.
- Compare the following landscapes: which one do you like best and why?
- Which type of agriculture do you consider better adapted to extreme weather?
- What will the conditions on these two farms be during long periods of hot and dry weather, strong wind, or heavy rain? Etc.

Prerequisites and possible follow-up minilessons:

Possible follow-up activities can be drawn from the other minilessons, namely Climate Map. In the minilesson, students create a map. Students focus on sources of climate risk as well as existing adaptation and mitigation measures. Based on a set of orientation questions, they explore their community in depth and draw links between local topics and contexts. They map their knowledge using a unique set of graphical symbols. The resulting map describes the climate situation of the community. The minilesson helps students realise that climate problems exist in their community, too, and find out how it is doing in terms of climate change.

Integrating the place and the community in the minilesson

Students spend a great part of the minilesson outside in the local community, studying the effect of heat on urban areas and life in them. While the minilesson is not designed to promote cooperation with the community, it can be extended to include a follow-up activity that does integrate such cooperation.

Application of PBL principles and the PBL Rung attained

Principles:

On-site learning – As learning steps outside the school, the community and its surroundings become the classroom.

Learning about the place – In the minilesson, students only begin to discover the possibilities of cooling their town. Thus, the principle of learning about the place is not fully applied. That will be the case in the follow-up minilesson, Climate Map, where students use their knowledge and skills to design local adaptation and mitigation measures.

Learning through the place – Students learn about the implications of the global problem of climate change by examining the impact on their community and its preparedness for climate change.

Learning for the place – The minilesson serves as an introduction to tackling the effects of heat and draught on one's place. Thus, the principle is not applied here. In the follow-up Climate Map minilesson, students can apply what they have learned in this minilesson to design, for example, a local adaptation measure as a real, tangible and useful contribution to quality of life and environmental quality in their community.

Place attachment – While the minilesson is not designed to promote place attachment, it helps students get to know different local places and reflect on the ways their community is prepared for the impacts of climate change.

Adapting to local situation – The minilesson responds to local conditions and needs, and the learning process is adapted to them. Focusing on the local impacts of heat and draught, students learn about the specifics of their community.

Personal relevance – Students find the learning process personally relevant, being able to see how it relates to their own lives. Students realise the impacts on their own lives. In discussions, students reflect on the ways they personally, together with others, can help prevent those risks.

Active involvement/participation of students – Students get actively involved in the minilesson by conducting experiments individually or in teams with fellow students.

Community partnership – While the minilesson is not designed to promote community partnership, it can be extended to include such activities of the follow-up minilesson, Climate Map, that are based on cooperation with the community.

Interdisciplinarity – The entire topic of climate change is interdisciplinary and cross-curricular. The minilesson integrates the subjects of Biology; Physics; Mathematics; Civics education; and Arts.

Full-fledged teaching tool – The minilesson integrates different areas across the curriculum (see above).

Cooperation – Learning occurs in the context of group work, with teamwork-based assignments.

Place-Based Learning Ladder (the rung attained by the minilesson is in bold):

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Rung 1
Lessons are adapted by adding local examples to existing teaching units.
Rung 2
Lessons are designed to include direct experiences of the place (or direct experiences of the place are added to existing teaching units).
Rung 3
Teaching unit is designed to use the advantages of the place and form a community partnership.
Rung 4
Integrated teaching unit based on PBL that involves service learning and a strong community partnership.