

WP4 NBS Academy Lesson Plan for Pre-service teachers

Date		Time		Duration	90 minutes	Target group	secondary school pupils (ages 12–14)
Subject	Biology; Natural Sciences; Environmental and Sustainability Education						
Topic	The Sponge City Principal; Impervious Surfaces and Urban Ecosystems						
Learning Outcomes	<ul style="list-style-type: none"> • To describe the environmental impact of impervious surfaces on urban water systems and biodiversity. • To simulate and interpret runoff differences between permeable and impermeable surfaces. • To link land-use decisions (e.g., soil sealing, greening) with sustainability outcomes. • To reflect on how to teach these concepts using participatory and inquiry-based methods. 						

Lesson objectives	Description of the activity	Assessment	NBS Thinking tool
Identify types of urban surfaces and explain how they disrupt the natural water cycle.	<p>Warm-up (15 min)</p> <ul style="list-style-type: none"> • Brainstorm: "What surfaces do you walk on each day?" <ul style="list-style-type: none"> ◦ Students create a quick mind map or sketch distinguishing permeable (e.g., grass, gravel, soil) from impermeable (e.g., asphalt, concrete, rooftops) surfaces. • Show satellite images or photos from their own city and identify sealed areas. <ul style="list-style-type: none"> ◦ Google Earth: https://www.google.com/earth/about/ 	What surfaces do you walk on each day?"	<p>Step 1 – Understanding the Challenge</p> <p>→ Students recognize impervious surfaces as a driver of urban flooding, biodiversity loss, and heat islands.</p>

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	<ul style="list-style-type: none"> o Open Street Map: https://www.openstreetmap.org/ • Short group discussion: <ul style="list-style-type: none"> o Why do cities have so many sealed surfaces? o What happens to rainwater in cities? 		
	<p>Theoretical input (15 min)</p> <ul style="list-style-type: none"> • Short slide presentation with visuals: <ul style="list-style-type: none"> o Definition of impervious surfaces o Consequences: increased runoff, flooding, erosion, urban heat, and loss of soil life o Introduction to NBS: how permeable paving, green roofs, rain gardens, and vegetated swales work o Local examples (Innsbruck): <ul style="list-style-type: none"> ▪ Schmerlingstraße in Innsbruck as an example of Sponge City adaptation ▪ Deep beds at Campus Technik, University of Innsbruck 		

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<p>Model and measure runoff on various surface types and interpret the environmental implications.</p> <p>Critically discuss the environmental consequences of surface sealing, such as flooding, erosion, and biodiversity loss.</p> <p>Develop practical ideas for implementing simplified runoff experiments in future classroom settings.</p>	<p>Hand-on group activity – runoff simulation (40 min)</p> <p>In this experiment-based activity, students simulate rainfall on different surface types (e.g. soil, turf, tile, gravel) to compare their effects on water infiltration, runoff, and erosion. By collecting and analyzing data, students experience how impervious surfaces impact urban ecosystems and how nature-based alternatives can improve resilience.</p> <p>□ <i>For detailed instructions see Activity description & worksheet</i></p>	<p>Completion of group data table and analysis</p> <p>Participation in runoff experiment and discussion</p> <p>Short written reflection or teaching idea proposal</p>	<p>Step 2 – Exploring Natural Systems → They compare how natural surfaces absorb and store water, mimicking ecosystem functions.</p> <p>Step 3 – Co-developing NBS Ideas → In the teaching transfer section, students brainstorm ideas for sustainable design and classroom integration.</p>
	<p>Reflection & Discussion (20 min)</p> <p>Plenary Reflection:</p> <ul style="list-style-type: none"> • What were the key differences in runoff and infiltration? 		

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	<ul style="list-style-type: none"> • How does surface type affect flood risk, urban heat, and biodiversity? <p>Deeper questions:</p> <ul style="list-style-type: none"> • What role do green spaces play in climate resilience? • What ethical considerations arise when designing public spaces: for people, water, or ecosystems? 		
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Summative Assessment:

- Evaluate the group's runoff data table for accuracy and clarity
- Collect a short written reflection on key insights and teaching transfer ideas (What connections do you see between urban planning and environmental education? / How did this activity help you think differently about teaching sustainability topics in schools?)

Suggested Reading:

- Pasquier, U., Vahmani, P., & Jones, A. D. (2022). Quantifying the City-Scale Impacts of Impervious Surfaces on Groundwater Recharge Potential: An Urban Application of WRF–Hydro. *Water*, 14(19), 3143. <https://doi.org/10.3390/w14193143>
- <https://www.deeproot.com/blog/blog-entries/how-impervious-cover-impacts-stream-ecosystems-and-what-we-can-do-about-it/>

