

Project Day 2

Schoolyard (Re)Design

Planning a Climate-Resilient School Ground

Analog and Digital Lesson Unit

Lower Secondary Level (all school types)

Middle School

Biology, Geography, Physics, Technology

Project day, 4-5 class periods

Classroom & School Grounds

Designed for middle school students, this project day explores the topic of the thermal benefits of green facades and demonstrates how findings from disciplinary and pedagogical research can be successfully integrated into the classroom to teach Education for Sustainable Development (ESD) as a cross-curricular theme.

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Content

Urban spaces–including school grounds–actively contribute to global climate change and are, at the same time, particularly affected by its impacts. During this project day, students will learn how schools can transform their grounds from being "part of the problem" to becoming active agents of climate adaptation.

While the first project day focused on the potential of urban green spaces using the example of green facades, Project Day 2 centers on biodiversity in urban areas, strategies for protection against extreme weather (heavy rain and heat), and the sustainable transformation of the entire schoolyard. In this process, the students–acting as experts–develop solutions for a sustainable and livable school environment.

Prerequisites

This teaching and learning unit builds on the module (Project Day 1) "Green Facades": Therefore, we recommend completing this module beforehand–though it is not strictly necessary.

Notes

The learning module is designed as a project day and lasts 4.5-5 hours, depending on the learning group. The development phase takes place in groups. We recommend 5 students per group.

Materials

- Presentation: (Re)Designing the Schoolyard
- iPads, projector, flip chart
- Floor plans, clipboards, colored pencils
- See the lesson plan for additional materials

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Learning Objectives

The goal is to show students the role and potential of the school grounds in the context of sustainable urban development: The project day addresses the specific risks posed by extreme weather events–such as heavy rainfall–to the school grounds, as well as the potential of green school grounds as a measure to protect the climate and adapt to climate change. The focus is on helping students understand the importance of biodiversity and the "sponge city" concept as effective strategies for creating a climate-resilient school environment.

Since the consequences of climate change are often associated with uncertainty, a central goal is to help students recognize their own self-efficacy through criteria-based mapping of their own school grounds and the use of digital tools. Through an expert role-playing exercise followed by a planning phase, they are ultimately empowered to develop multi-perspective planning approaches and actively negotiate their own, real-world-based options for a sustainable redesign of the school grounds.

Competency Areas

Application of Subject Matter Knowledge

Students can...

- **explain** the concept of biodiversity as well as its significance, functions, and threats in urban areas.
- **Describe** the specific impacts of climate change on cities, particularly the phenomenon of heavy rainfall and the resulting hazards.
- **Explain** the concept of the "sponge city" as well as the ecological and climatic benefits of green roofs (water storage, heat protection, species conservation).

Communication

Students can...

- document the current state of the school grounds based on specific criteria and **record** the results in the form of a map on a site plan.
- **discuss** multi-perspective planning approaches as part of an expert role-play followed by a planning phase, take responsibility for subprojects, and **negotiate** design elements for a climate-resilient school grounds **in a fact-based manner**.
- **Gather** information from digital sources (e.g., Geoportal Deutschland) and **use** it to support one's own planning ideas.

Gaining Insights

Students can...

- conduct systematic surveys through on-site exploration, **identifying** areas of use and ecological potential.
- use digital geographic information systems such as the Geoportal Deutschland (heavy rain hazard map) or Google Maps to **locate** flood-prone areas and suitable sites for greening measures at their own school campus.
- interpret legends and thematic maps and use them **to deduce** connections between land sealing and climate-related risks.

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Competency Areas

Assessment

Students can...

- critically **evaluate** the current layout of their school grounds in terms of climate resilience and biodiversity.
- **weigh** various interests and expert positions (e.g., fire safety, insurance coverage) against one another during the planning process and **form** their own, well-reasoned position on the redesign.
- **Recognize and appreciate** the importance of their own options for action in adapting to climate change in their immediate living environment.

Factual Analysis

Urban Ecosystems and the Heat Island Effect

Urban spaces are characterized by specific site conditions that distinguish them from near-natural areas; these conditions are studied within the framework of urban ecology (Endlicher, 2012). A key characteristic is increasing densification and large-scale land sealing, which prevents the natural exchange of air and water (Endlicher, 2012). As a result, energy can no longer be absorbed through evaporation processes (latent energy) but is instead directly converted into sensible heat, causing air temperatures to rise (Endlicher, 2012). This effect, combined with heat-retaining materials and a lack of vegetation, creates the phenomenon of urban heat islands, where temperatures in the city can be up to 10 °C higher than those in the surrounding areas (Bundesverband Garten-, Landschafts- und Spielplatzbau e.V., 2020).

Biodiversity in Urban Areas

Biodiversity encompasses species diversity, genetic diversity, and ecosystem diversity (CBD, 2011). In cities, the biosphere is strongly shaped by human influences. The main threats to biodiversity are habitat destruction due to development and environmental pollution (Wittig, 2012). Nevertheless, cities provide niches for adapted "urbanophile" plant species and a specific urban fauna (Endlicher, 2012). Promoting biodiversity–for example, by allowing wild vegetation to grow or by creating near-natural school gardens–is essential, as it forms the basis for vital ecosystem services such as climate regulation and oxygen production (Zedda et al., 2023).

The Challenge of Heavy Rainfall and the "Sponge City" Concept

In addition to heat, climate change poses a challenge to cities in the form of increasing extreme rainfall events, which occur when unusually high amounts of precipitation fall in a short period of time (DStGB & Difu, 2022). Since impervious surfaces cannot absorb water, surface runoff increases dramatically, which overloads the urban sewer system and can lead to flooding. A forward-looking solution is the transformation into a "sponge city." The goal is to store stormwater where it falls, rather than draining it away immediately (Federal Environment Agency, 2019). Basins, swales, and green roofs and facades serve as effective water storage systems that delay runoff and, through evaporation, also help cool the environment (Probst, 2021).

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Analysis and Planning Tools:

Mapping and Geodata

In order to plan climate adaptation measures effectively, a systematic analysis of the current situation is necessary. The mapping method enables students to consciously perceive real-world spaces and document structures–such as land-use zones or the degree of soil sealing–on floor plans (Lindau, 2010). Digital geographic information systems, such as the Geoportal Deutschland, supplement this analysis with specialized scientific data. Heavy rainfall hazard maps can be used to identify potentially vulnerable low-lying areas in the school's surroundings, while the Google Maps satellite view provides information on the suitability of roof surfaces for greening measures (Geodateninfrastruktur NRW, 2025; Federal Environment Agency, 2019).

References

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Schedule for the Project Day

Introduction



The teacher begins the day with a review of the content from Project Day 1 (heat in the city, urban densification, the positive effects of urban green spaces, and the potential of green facades). The relevance of the topic is highlighted with the focus: "We're making our school grounds ready for the future." In addition, the concept of biodiversity in an urban context, as well as its importance and the threats it faces, is explained. The students brainstorm ideas on this topic as a group and compile them on a poster

Media: Projector, flip chart

Materials: "Schoolyard (Re)Design" presentation, "Biodiversity" flipchart poster

Problem Statement



Using their own school as an example, students explore the issue of monotonous, impervious surfaces without shade, which have a negative impact on health and well-being and contribute to the heat island effect as well as the risk of flooding. In a plenary session, the students gather initial information about the current state of their school grounds on a flipchart poster to sharpen their focus for the subsequent tour. Together, they formulate the goal: to plan a nature-oriented, climate-resilient school grounds.

Media: Projector, flip chart

Materials: "Schoolyard (Re)Design" presentation, "Current State" flipchart poster

Development & Documentation



The development phase is divided into three methodological focuses:

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Mapping 1

Procedure

Working in small groups, the students conduct a systematic survey of the school grounds and document areas of use as well as existing vegetation on a site plan.



Figure 1: Student mapping the school grounds on a floor plan; floor plan taken from GEOportal.NRW

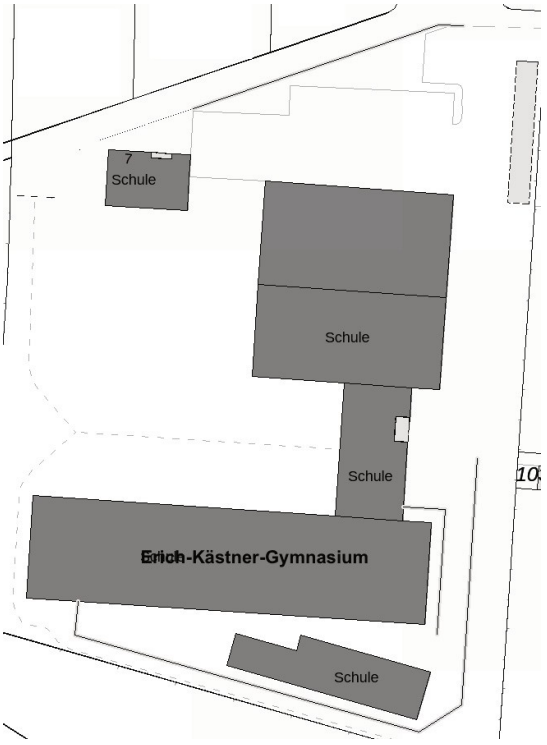


Figure 2: Example of a screenshot showing a floor plan of the Erich-Kästner-Gymnasium school grounds, taken from GEOportal.NRW

Mapping Session:

Back in the plenary session, the small groups present their key observations from the mapping exercise to the class.

Materials: Floor plans, clipboards, Worksheets 1 + 2 (see file AB_ZBS), colored pencils

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Activity: Heavy Rain & Sponge City 2

Procedure

Back in the plenary session, the instructor introduces the phenomenon of heavy rain. An explanatory video is used to illustrate how impervious surfaces overload the sewer system and why the concept of the
"Sponge City" represents a solution strategy. Students then use tablets to analyze digital heavy rainfall hazard maps via the Geoportal Deutschland and potential flat roofs as green roofs (use Worksheet 3) for their location using the Google Maps satellite view. The students mark the analyzed areas on the map using different colors (blue = heavy rainfall; green = green roof).



Figure 3: GEOportal.NRW

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Procedure



Figure 4: Mapping examples showing identified heavy rainfall hazard and green roof areas

Reinforcing Knowledge of Heavy Rain & Sponge City:

Knowledge about heavy rainfall is immediately reinforced and consolidated through a digital quiz (QR code, in the "Schoolyard (Re)Design" presentation).

The results from the heavy rain hazard map and the potential green roofs (flat roofs from the Google Maps satellite view) are recorded on transparent sheets that are placed over the school's floor plan.

Media: Projector, tablets

Materials: "Sponge City" explanatory video (linked in the "(Re)Design Schoolyard" presentation), Worksheet 3 (see file AB_ZBS), clipboards, floor plans, DIN A3 transparencies, transparency markers (blue/green)

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Development of Expert Role-Play & Planning Phase 3

Procedure



To prepare for future planning, the students take on various roles: school representative, teacher, landscape architect, fire department, and insurance company. Working individually, they first use role cards to identify specific requirements for the site (e.g., safety, usage requirements, aesthetics, accessibility). In the subsequent planning phase, these multi-perspective approaches are discussed in small groups to select design elements for the "school grounds of the future."

Documentation of Expert Role-Play & Planning Phase:

The students document their role-specific knowledge in a table, which is used for the subsequent small-group discussion. The small groups record the results of the planning discussion in bullet points in a tabular summary on the "Planning" poster, which serves as the binding basis for the later model-building activity.

Materials: Expert role cards (see file AB_ZBS), expert tables, Worksheet 4 (see file AB_ZBS), poster template "Table: (Re)Designing the Schoolyard,"

Transfer



Through the role-playing exercise, students come to understand the complexity and functions of real-world urban planning processes and the conflicts of interest that can arise in the process. The "as-is" master plans developed using transparencies and planning posters serve as a direct bridge to the practical implementation of the design elements in model building, which (ideally) takes place on the following project day. In addition, students discuss which of the planned measures (e.g., soil restoration, green roofs) could actually be implemented at their own school.

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Notes & Tips

Group size: We recommend a maximum of 5 students per small group to ensure active participation by all. In addition, there are five different expert roles.

IT Preparation: Make sure that access to the Geoportal Deutschland has been tested in advance on the tablets (via a browser) and that students are familiar with the filter (Heavy Rain Hazard Map). For the analysis of green roof potential using Google Maps, ensure that students select the satellite view under "Map Type" so they can identify flat roofs.

Support: It is advisable to have support from teaching assistants or upper-level students during the site walkthrough and digital analysis.

Mapping Preparation:

- Create a floor plan of your own school using the map tool and insert it on slide 24 of the presentation.

  TIP: Take a screenshot of the floor plan using the Google Maps standard view and insert it into the presentation.

- Convert the floor plan screenshot to PDF or JPEG, print it on DIN A3 paper for each small group, and attach it to a clipboard (DIN A3 clipboard -> easy to make yourself using plywood and clips)

Each small group receives information on 5 different expert roles, which are distributed among the group members. TIP: Do not hand out the answer sheet at this point.

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