Greenery and education

The positive effects of greenery in urban environments

V 4.0

Greenery in and around schools, day-care centres and on campuses is good for the living environment in and around these educational institutions. It has a positive effect on the health and general well-being of schoolchildren, students and staff and, as well as enhancing the social climate, it improves schoolchildren's and students' performance and their ability to concentrate. This document provides information on the benefits of greenery in relation to learning and well-being, including references to scientific literature. It concludes with some tips on how to ensure the successful and full inclusion of greenery.

What does greenery do?

- Greenery in classrooms purifies the air: it reduces concentrations of CO_2 and volatile organic compounds, keeping the air fresh and healthy.

Proven successes

- A practical study in eight primary school classes showed a 20% increase in learning performance when the classroom contained plants.[1]
- Outdoor vegetation curbs heat in and around the school in the summer, reducing heat stress and artificial cooling requirements.
- Green roofs and façades increase insulation capacity: lower heating costs in winter and cooler temperatures in summer.
- Indoor plants release water vapour and humidify the air, reducing headaches and improving concentration.
- Visible greenery, both indoors and outdoors, reduces stress and improves concentration.
- Green schoolyards encourage playing outdoors and foster a better social climate.

Applications

- Green roofs and façades
- Plants in canteens, central spaces and, where possible, in classrooms and lecture halls
- Green partitions and mobile planters
- Green borders, possibly doubling as vegetable gardens
- Trees in schoolyards and campuses
- Hedges around the premises
- School gardens
- Children in classrooms with plants show a 7% reduction in health problems.[1]
- 'Green' schoolyards are less prone to vandalism. 'Also, the children not only leave the plants in the ground, but they are also careful not to step on them and leave them alone,' says one schoolteacher.[2]
- At eight primary schools in New York, the integration of school gardening in the curriculum increased physical activity and lowered sedentary behaviour.[3]
- Students expect to be able to recover from study pressure better in a green campus yard than in a standard grey campus yard.[4]
- Students' recall of lectures is better when the lecture hall contains some natural elements.[5]
- Students prefer a green study space to a standard study space or one with a colourful poster.[6]

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Greenery and education

More information on the effects of greenery

Temperature

Schools are nearly always situated in urban areas, where the high rate of built-up and hard-surfaced areas often results in higher temperatures when compared with rural areas (the heat island effect). This effect occurs in metropolitan cities as well as in provincial towns and village centres, and increases as built-up areas become denser. The maximum differences measured vary from one to several degrees, with peak values reaching around 8ºC and incidental values even exceeding 10ºC. Heat stress affects concentration and learning performance, and extreme values or extended duration can also adversely affect health. Research has shown that 35% of urban areas in the Netherlands already experience heat stress at least seven days a year. Increasing urban density and global warming will increase the frequency of these periods of heat stress. However, greenery can help to lower urban temperatures. It can also be used specifically to improve the living environment in and around schools and other educational institutions.

How greenery works

- During hot weather people, including children and teaching staff, feel more comfortable in a green environment.[1]
- Green roofs, possibly combined with green façades, improve insulation of school buildings, improving the indoor climate. Heating and cooling costs also drop as a result.[2]
- Shade from trees increases thermal comfort during hot weather in two ways: by providing shade and by releasing water vapour. Although in the Netherlands the reported effects on air temperature are limited to 1-2ºC, the effect on the perceived temperature is many times higher.[1,3]
- In classrooms with a green wall and plants temperatures are lower and humidity is higher than in classrooms without plants.[4]

Recommendations

- Green façades and green roofs on top of school buildings improve insulation and help to reduce heating and cooling costs.
- Planting shade trees in the schoolyard increases possibilities during hot weather, making the schoolyard a more appealing place to play.
- Planting shade trees in car parks prevents the heating up of cars and makes the surroundings greener.
- Greenery in classrooms creates a more pleasant indoor climate.

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More information on the effects of greenery

Air quality

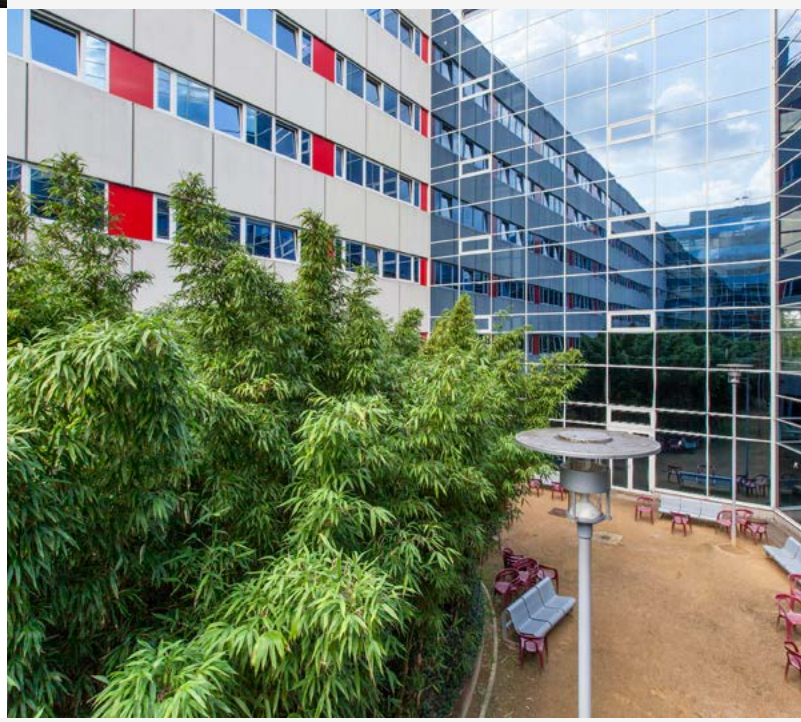
Major air pollutants in urban areas, including nitrogen oxides (NOx), particulates (PM10/PM2.5) and volatile organic compounds such as benzene, mainly come from industry and traffic. Long-term exposure causes lung problems and cardiovascular disease. Although air quality in most locations in the Netherlands complies with the applicable standards, this does not mean the risk is fully eliminated. There is no safe lower limit and concentrations can rise significantly, especially in areas close to busy roads and intersections.
In addition, air quality inside schools is often poor; having large numbers of children and teachers in a relatively small space frequently causes CO_2 levels to rise significantly. Moreover, volatile organic compounds from construction materials, including formaldehyde and benzene, may be present.
Greenery can help to improve indoor as well as outdoor air quality, benefiting overall health in the long term. In the short term greenery reduces stress and improves concentration and general well-being.

Recommendations

- Planting dense vegetation (green screens) can help to protect schools from air pollution from nearby sources, including busy roads.
- Indoor greenery in the form of potted plants or green walls improves air quality in classrooms and contributes to increased learning performance and fewer health problems among schoolchildren.

How greenery works

- Dense vegetation limits the flow of polluted air from busy roads into school environments.[1]
- Given enough light and water, plants absorb CO_2 from the air, helping to reduce ambient CO_2 levels. In a test with plants in classrooms CO_2 concentrations were 10-20% lower in classrooms with plants than in classrooms without plants.[2]
- Plants are also able to capture volatile organic compounds (VOCs) such as formaldehyde and benzene from the air. A study at a school in Portugal showed that plants can reduce concentrations of airborne VOCs by 50%.[3]
- Plants regulate the temperature of their leaves through transpiration. The evaporated water increases relative humidity in classrooms, which can reduce the rate of schoolchildren suffering from headaches.
- Concentrations of CO_2 and volatile organic compounds appeared to be lower in classrooms with a green wall and plants than in a control classroom without plants.[4]



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Greenery and education

More information on the effects of greenery

Concentration

To learn effectively, schoolchildren must be able to concentrate. Of course this largely depends on the teacher's skills and enthusiasm and on schoolchildren's interests and aptitude. However, research has shown that a school's physical environment also has an effect and that greenery in schools can be beneficial.

Recommendations

- Make sure greenery is visible from the classrooms; especially the presence of trees and shrubs (as opposed to 'bare' grassy areas) seems important.
- Create pleasant green outdoor spaces that can be used by schoolchildren and teachers to relax and take some time out (relaxation areas in the schoolyard).
- Also place plants or a green wall in classrooms.

How greenery works

- Plants in classrooms can promote more social behaviour among young people and reduce sickness absence.[1]
- Green walls in classrooms improve schoolchildren's concentration and attention levels.[1]
- Views of greenery from classrooms where schoolchildren take breaks help to restore concentration more quickly and reduce stress.[2]
- Laboratory research shows that even a brief view of a green roof can have positive effects.[3]
- Greener school grounds and greener outdoor spaces correlate with improved cognitive development (working memory and concentration).[4]
- Schoolchildren's concentration levels after recess are higher at schools with green schoolyards than at those with grey schoolyards. Teachers confirm this.[5]
- Secondary schoolchildren demonstrate better concentration when there are plants or flowers in the classroom.[6]
- More greenery in the living and school environment, especially in the form of trees, is associated with improved concentration among adolescents.[7]

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Greenery and education

More information on the effects of greenery

Physical activity

A lack of physical activity and, by extension, obesity are key risk factors for health. In the Netherlands 14% of young people are overweight (Statistics Netherlands, 2016). Traditionally the focus was always on moderately and highly intensive activity; no distinction was made between light activity and sedentary behaviour (e.g. sitting). More recently it has become clear that sedentary behaviour is a risk factor in itself and there is now an international guideline for children: a daily maximum of two hours of spare time watching television or playing on the computer. A varied range of physical activities is also important for developing children's motor skills. Green environments can provide the space for this and stimulate this behaviour.

Recommendations

- Create an attractive outdoor area and offer a variety of playtime activities and games; make sure the area is large enough so that children are not in each other's way.
- Integrate vegetation with the other elements in the schoolyard so it is not mere decoration.
- Ensure that the greenery can cope with the intensity of use of the schoolyard.
- Vegetable gardens may spark children's interest in nature.
- Create a challenging but safe outdoor area. Do not use poisonous plants and comply with the safety requirements.

How greenery works

- Young children at day-care centres with high-quality green outdoor spaces spend more time outside and have lower rates of obesity.[1]
- Large green outdoor spaces encourage physical activity among boys and girls of primary school age and especially help girls to keep active over the years.[2]
- Children who often play in green areas where a variety of playtime activities are available demonstrate better motor development.[3]
- Keeping a vegetable garden at school helps to reduce a sedentary lifestyle among children.[4]
- Among girls greener schoolyards encourage moderately intensive physical activity during recess. When a schoolyard is greened, girls spend less time standing around talking and watching others, and engage more in rule-based games.[5]

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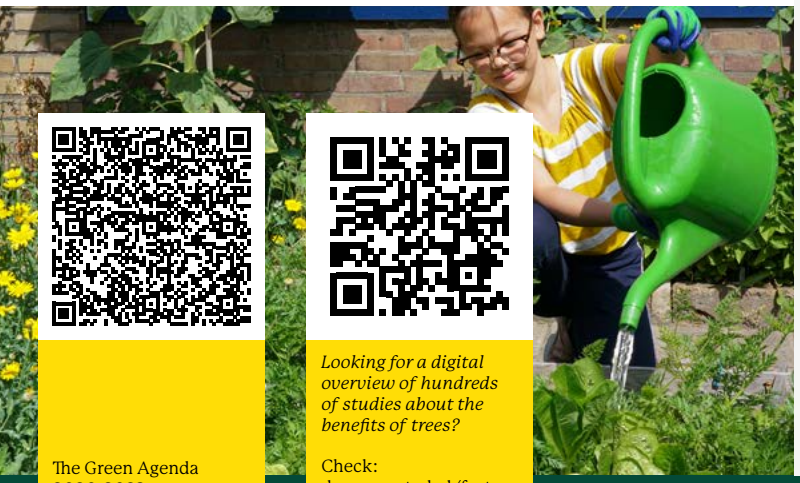
More information on the effects of greenery

Social climate

In addition to children's cognitive and physical performance, their socio-emotional well-being and development are essential. Some aspects of this are self-confidence, empathy, respectful behaviour, helping one another, learning to cooperate, etc. The social climate is an important element in this context, also in the schoolyard.

How greenery works

- An attractive and functionally well-designed green schoolyard can help to improve the social climate in the schoolyard and ultimately children's overall well-being.[1]
- School vegetable gardens, for example, can stimulate children to eat more fruit and vegetables and improve levels of 'green literacy'.[2]
- Some of the benefits (e.g. of keeping a vegetable garden) can also have an effect on the parents.
- Children whose schoolyard has been greened experience a greater sense of social support from their peers.[3]



The Green Agenda 2020-2023

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Recommendations

- Provide a varied range of playtime activities (something for everyone) as well as places where children can retreat and/or take some time out.
- Include proper outdoor furniture and covered spaces where necessary.
- Adequate open spaces encourage team sports, including various ball sports.
- The use of play equipment will encourage children to play together.
- The benefits of urban green areas are deemed conducive to urban residents' health and well-being, but it is essential to divide the benefits equally among the residents, with special attention for elderly people with dementia, people with mental health problems and people from deprived urban areas. Successful inclusion strategies in this context are based on the coordination between private initiatives and public actions.[4]

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Further information

This fact sheet is one of a series of five fact sheets on the added value of greenery in our living environment. The other fact sheets take a closer look at greenery in residential, work, healthcare and general contexts.

The fact sheets were updated in 2022, funded by the Horticulture & Propagation Materials Top Sector as part of the tailored knowledge programme The Green Agenda. Partners of this programme are Stichting de Groene Stad and Wageningen University & Research.

More information can be found on the websites of De Groene Stad, Groen Kennisnet and Wageningen UR:

https://www.wur.nl/nl/onderzoek-resultaten/onderzoeksprojecten-lnv/expertisegebieden/kennisonline/de-groene-agenda-2020-2023-valorisatie-van-groene-kennis-voor-een-klimaatadaptieve-en-leefbare-stad.htm

- www.degroenestad.nl
- groene-agenda.nl
- groenkennisnet.nl

There are many examples of applications and studies that illustrate and prove the added value of vegetation. Other useful sources of information include:

- https://ruimtelijke adaptatie.nl/hulpmiddelen/factheets-groen/

Here you will also find a table listing 120 tree species and their specific benefits as vegetation.

A useful tool for the design of a green healthy city is available at

- https://tools.wenr.wur.nl/groenegezondestad/

Specific questions on reference projects, research results, etc., can be sent directly to info@degroenestad.nl.

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