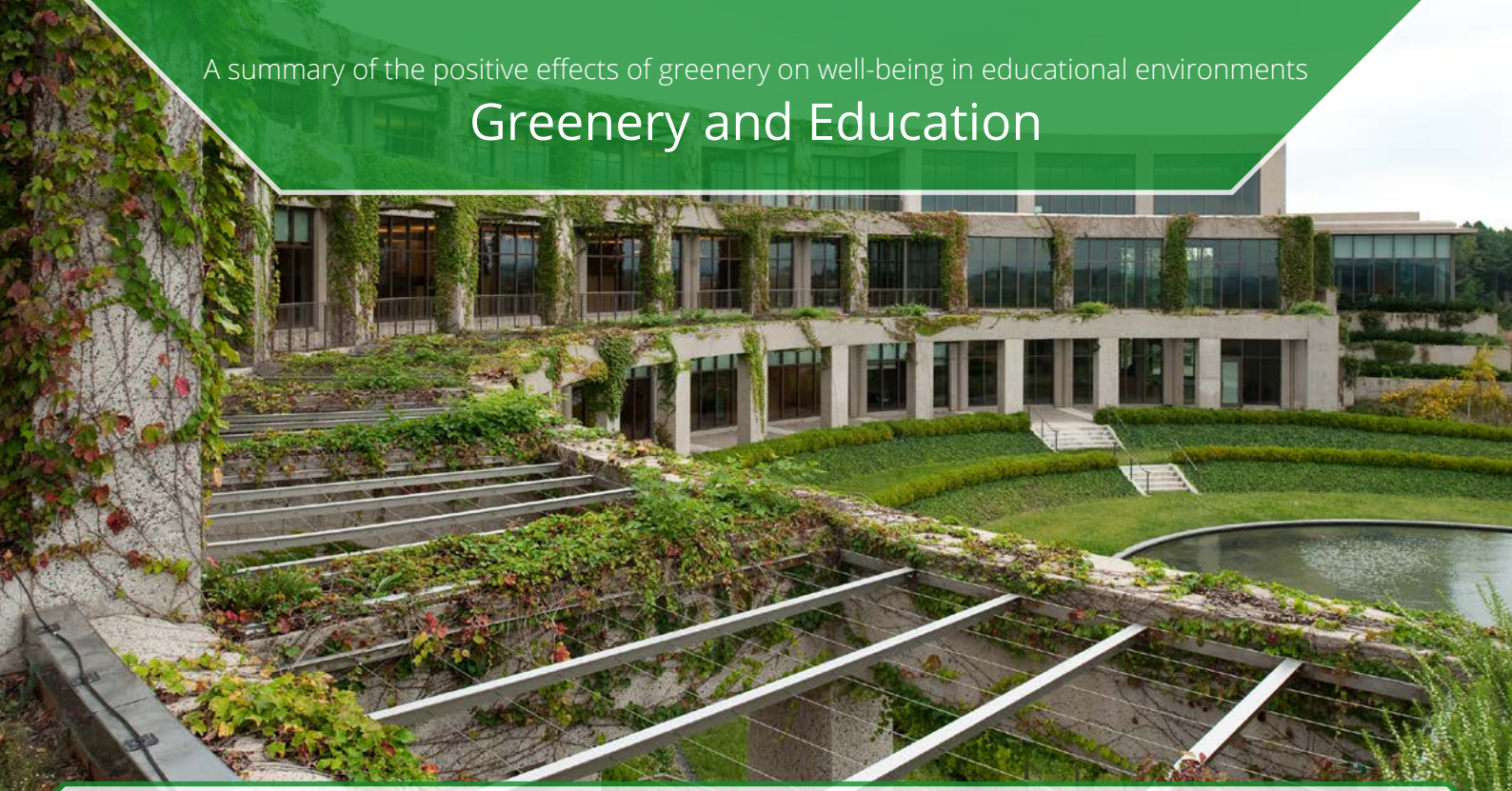
A summary of the positive effects of greenery on well-being in educational environments

Greenery and Education



Greenery in and around schools, childcare centres and on campuses is good for the climate at education institutions, both inside and out. It has a positive effect on the health and general well-being of students and staff alike, improving student performance and their ability to concentrate, as well as fostering the social climate. This document provides information on the benefits of greenery in relation to education and well-being, including references to scientific literature. It concludes with some tips on how to ensure the successful and beneficial 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.
- Outdoor vegetation combats the summer heat in and around the school, meaning less heat stress and less artificial cooling.
- Green roofs and facades increase insulation capacity, reducing both heating and cooling expenditure.
- Moisture released into the air by plants helps with dry atmospheres, reducing headaches and improving concentration.
- Visible greenery, both indoors and out, reduces stress and increases the ability to concentrate.
- Green playgrounds encourage playing outdoors, and foster a better social climate.

APPLICATIONS

- Green roofs and facades.
- Plants in the canteen, central spaces and (where possible) in classrooms/ lecture theatres.
- Green dividing walls and mobile planters.
- Green borders, possibly doubling as vegetable gardens.
- Trees in the playground or on campus
- Hedges surrounding the premises.

PROVEN SUCCESS

- A practical study in eight primary school classes showed a 20% increase in performance when plants were included in the classroom. [1]
- Children in classrooms that include plants show a 7% reduction in health problems. [1]
- 'Green' playgrounds are less susceptible to vandalism: '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 8 primary schools in New York, the integration of gardens into the school curriculum increased physical activity and lowered sedentary behaviour. [3]

Sources:

1. *Rapport Project 'Plant in de klas' [Plants in the class-room] Productschap Tuinbouw/Fytagoras/Netherlands Organisation for Applied Scientific Research (TNO) 2011.*
2. *Alterra report 'Meer groen op het schoolplein' [More greenery in playgrounds] (http://edepot.wur.nl/283415).*
3. *Van den Berg, A.E. et al. 2016. Green walls for a restorative classroom environment: a controlled study. Environment and Behaviour 2016:1-23.*

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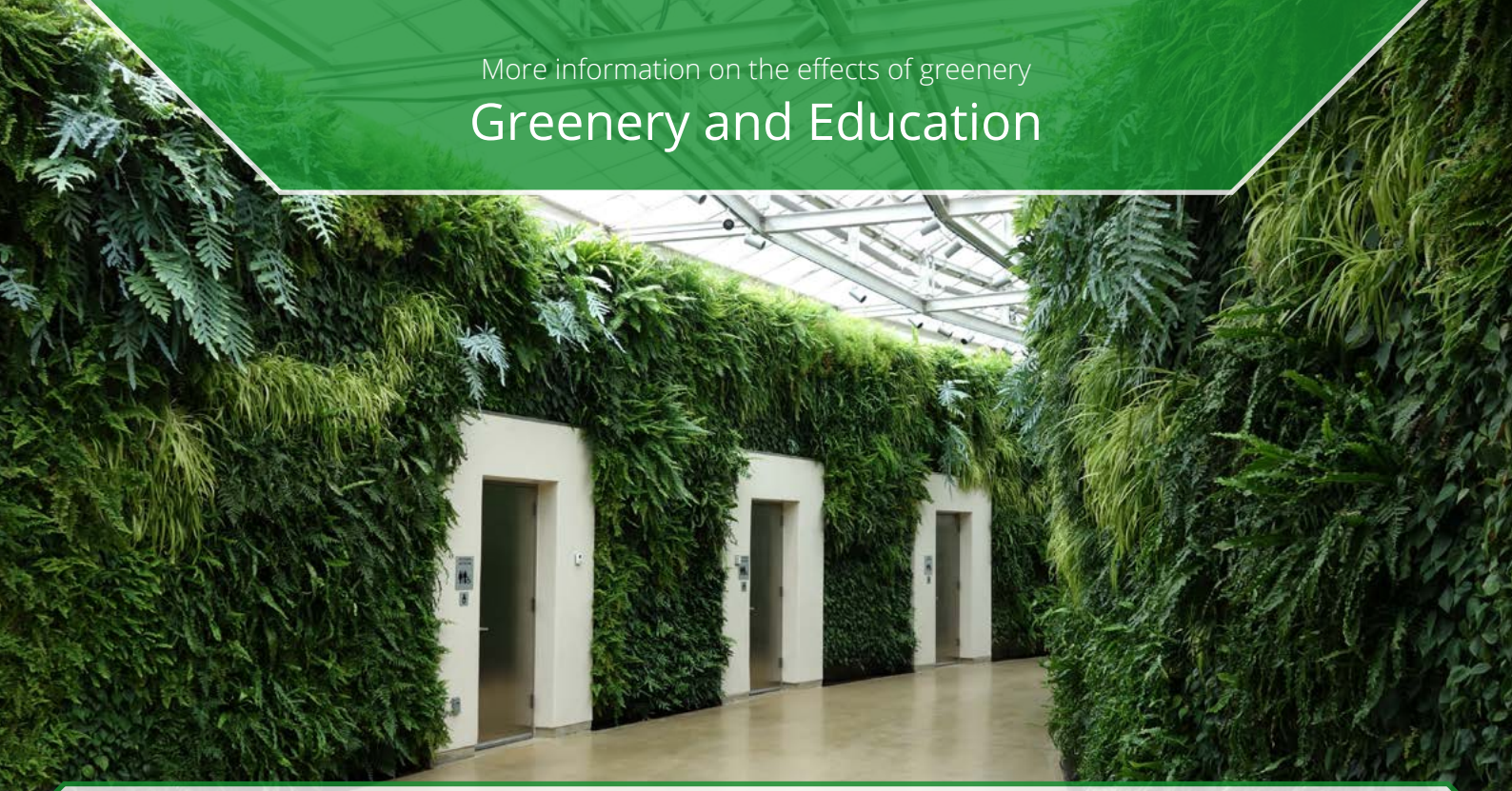

TEMPERATURE

Schools are almost always situated in urban areas, where the higher percentage of built-up and surfaced areas generally produces higher temperatures (the 'heat-island' effect). This effect occurs in both metropolitan and provincial cities, and increases as built-up areas become denser. Measured maximum differences vary from one to several degrees, with peak values reaching around 8 °C and incidental values even exceeding 10 degrees. Heat stress affects the ability to concentrate, 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 7 days per year. Rising urban density and global warming will increase the frequency of these heat-stress periods. Heat stress negatively affects the ability to concentrate. However, greenery can help to lower city temperatures.

HOW GREENERY WORKS

- All people, including children and teaching staff, feel more comfortable in green environments when temperatures are high. [1]
- Green roofs (potentially in combination with green facades) increase insulation in school buildings, improving the learning environment. Heating and cooling expenditure will also drop as a result. [2]
- Shade trees above playgrounds increase thermal comfort during warmer weather, increasing playtime opportunities. [3]

RECOMMENDATIONS

- Applying green facades and roofs to school buildings improves insulation, helping to reduce heating and cooling costs.
- Planting shade trees in the playground will provide more opportunities to play during warm weather, and makes the playground a more appealing place to play.

Sources:

1. *Klemm, W., Heusinkveld, B. G., Lenzholzer, S., & Hove, B. v. (2015). Street greenery and its physical and psychological impact on outdoor thermal comfort. Landscape and Urban Planning, 138, 87-98.*
2. *Hop, M.E.C.M. & Hiemstra, J.A., 2013. Ecosysteemdiensten van groene daken en gevels: Een literatuurstudie naar diensten op het niveau van wijk en stad [The ecosystem services provided by green roofs and walls: A literature study on services at district and city level].*
3. *Gromke, C., Blocken, B., Janssen, W., Merema, B., van Hooff, T., & Timmermans, H. (2015). CFD analysis of transpirational cooling by vegetation: Case study for specific meteorological conditions during a heatwave in Arnhem, Netherlands. Building and Environment, 83(0), 11-26.*

Compilation: Wageningen University & Research: J.A. Hiemstra, S. de Vries and J.H. Spijker.

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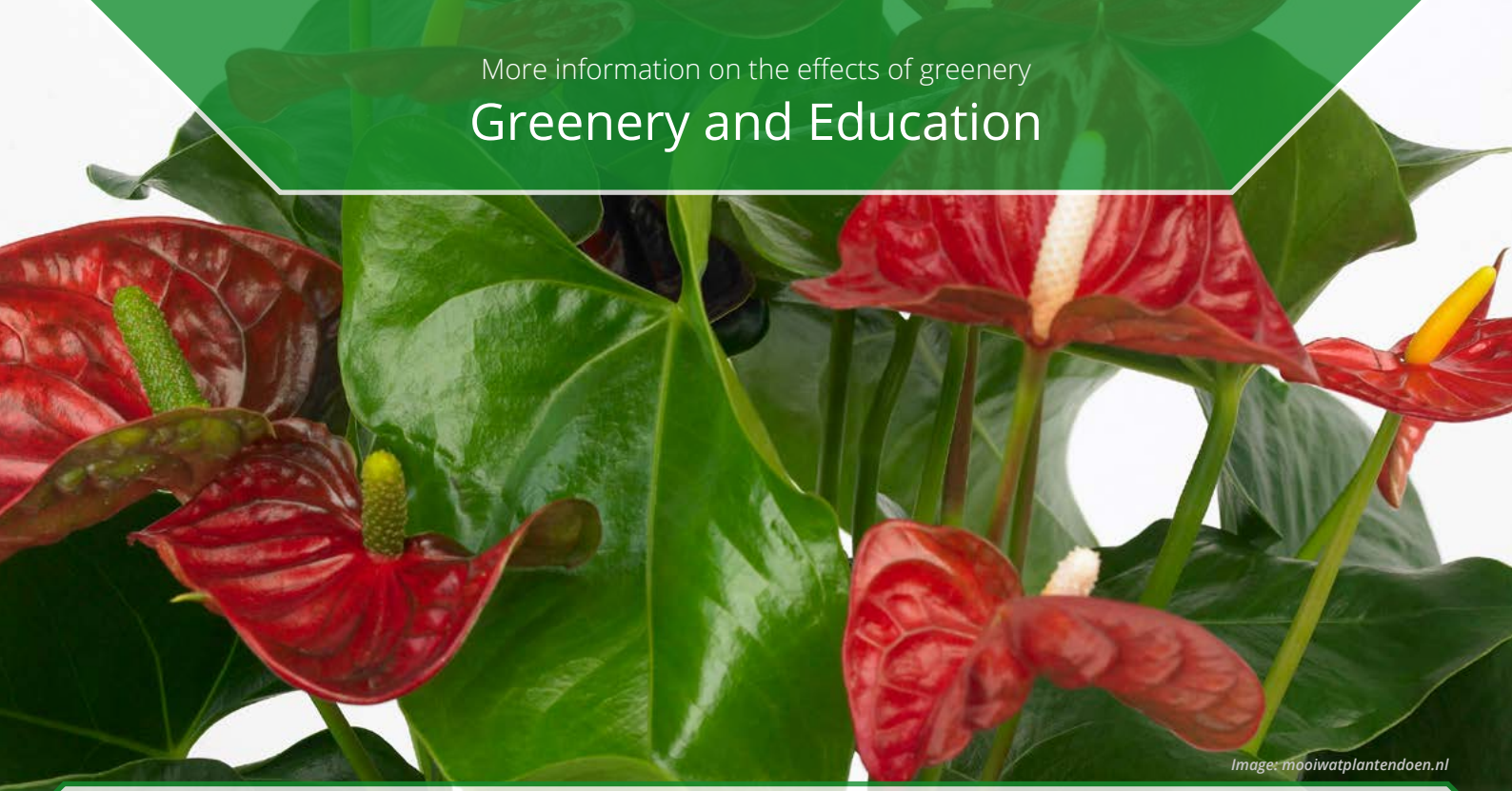

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AIR QUALITY

The major air pollutants in urban areas (nitrous oxides (NO_x), particulates (PM10/PM2.5) and volatile organic compounds such as benzene) come from industry and traffic. Long-term exposure to these substances leads to lung problems and cardiovascular disease. Although air quality at most locations in the Netherlands complies with standards, this does not mean the risk is eliminated entirely. There is no safe lower limit, and concentrations can rise considerably in areas close to busy roads and intersections.
Indoor air quality in schools is also often poor; large numbers of children and teachers in a relatively small space frequently causes CO_2 levels to rise significantly. Volatile organic compounds from construction materials (such as formaldehyde and benzene) may also be present. Greenery can help to improve air quality both indoors and outdoors, benefiting overall health in the long term. In the short term, greenery relieves stress and improves concentration and general well-being.

HOW GREENERY WORKS

- Dense vegetation limits the flow of air pollution 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. A study of classrooms containing plants showed a 10-20% drop in CO_2 concentrations compared to classrooms without plants. [2]
- Plants are also able to absorb formaldehyde and benzene from the atmosphere. A study at a school in Portugal showed that plants can cause a 50% drop in volatile organic compounds (VOCs) in the air. [3]
- The water vapour increases the relative humidity in classrooms, which can reduce the percentage of students suffering from headaches.

RECOMMENDATIONS

- Planting dense vegetation (green screens) can help protect schools from air pollution from nearby sources, such as busy roads.
- Indoor plants (such as pot plants or green walls) improve air quality in classrooms and contribute to increased student performance and fewer health problems.

Image: mooiwatplantendoen.nl

Sources:

1. *Teeuwisse, S., Haxe, L. & van Alphen, A., 2013. Schone lucht; groen en de luchtkwaliteit in de stad. Eindrapport Interregproject 'Toepassing functioneel groen: luchtgroen, klimaatgroen, sociaal groen' [Clean air; greenery and urban air quality. Final report from the interregional project titled 'Functional applications of greenery: for air, climate and society'.] Publication by the Municipality of Tilburg/ Municipality of Sittard-Geleen/Royal Haskoning DHV Rotterdam.*
2. *van Duijn, B., Klein Hesselink, J., Kester, M., Jansen, J. & Spitters, H., 2011. Report: 'Plant in de klas' [Plants in the classroom]. PT/Fytagoras/TNO.*
3. *Pegas, P.N., Alves, C.A., Nunes, T., Bate-Epey, E.F., Evtyugina, M. & Pio, C.A., 2012. Could Houseplants Improve Indoor air Quality in Schools? Journal of Toxicology and Environmental Health, Part A, 75:22-23, 1371-1380.*

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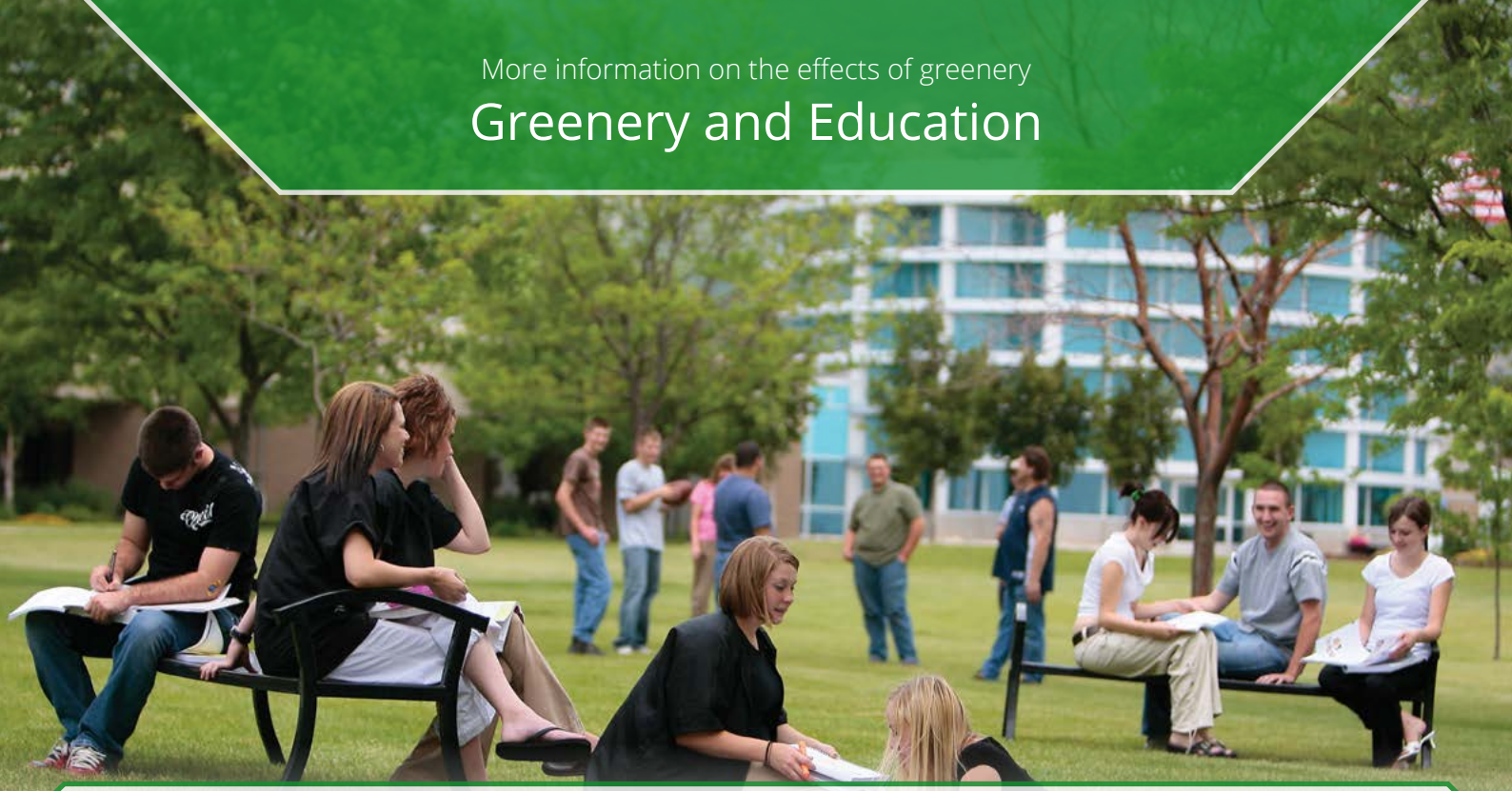

CONCENTRATION

To learn effectively, students must be able to concentrate. Of course this depends a great deal on the teacher's skills and enthusiasm, as well as a student's own 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.

HOW GREENERY WORKS

- Plants in classrooms can promote more social behaviour among young people, and reduce levels of illness. [1]
- Green walls in classrooms help students' ability to concentrate, and raise attention levels. [2]
- Views of greenery from classrooms where students take breaks helps restore concentration more quickly, and reduces stress. [3]
- Even a brief view of a green roof can have positive effects, according to laboratory research. [4]
- Greener school grounds and external surrounds correlate with improved cognitive development in terms of working memory and concentration. [5]

RECOMMENDATIONS

- Make sure students can see greenery from classrooms; the presence of trees and shrubs seems particularly important (i.e. not 'bare' grassy areas).
- Create pleasant green outdoor spaces that can be used by students to relax and get away from it all (relaxation areas on the school grounds).

Sources:

1. *AE van den Berg, JE Wesselius, J Maas & K Tanja-Dijkstra (2016) Green Walls for a Restorative Classroom Environment: A Controlled Evaluation Study. Environment and Behavior.*
2. *Van den Berg, A.E. et al. 2016. Green walls for a restorative classroom environment: a controlled study. Environment and Behaviour 2016:1-23.*
3. *Li, D., Sullivan WC, 2016, Impact of views to school landscapes on recovery from stress and mental fatigue in Landscape and Urban Planning 148 149–158.*
4. *Lee KE, Williams KJH, Sargent LD, Williams NSG, Johnson KA, 2015, 40-second green roof views sustain attention: The role of micro-breaks in attention restoration in Journal of Environmental Psychology 42 182-189.*
5. *Kruid, S., 2016. Systematic literature review: school and community garden interventions in children. BSc-Thesis Wageningen University.*

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PHYSICAL ACTIVITY

A lack of physical activity (and, by extension, obesity) is a key risk factor for health. Fourteen percent of young Dutch people are overweight (Netherlands Organisation for Applied Scientific Research (TNO), 2010). Traditionally, exercise has always focused on moderate to intense activity – no distinction has been drawn between light activity and sedentary behaviour (e.g. sitting). Recent results show that sedentary behaviour is a risk factor in itself, and an international guideline for children has already been developed: no more than two hours of free time at the television or computer per day. A diverse range of physical movements is also important for developing children's motor skills. Green environments can offer both the space and encouragement for them to do so.

HOW GREENERY WORKS

- Young children at childcare centres with quality, green outdoor spaces spend more time outside, and show lower rates of obesity. [1]
- Large green outdoor spaces encourage physical activity among primary-school-aged children, and also help girls especially to keep active through the years. [2]
- Children who often play in green areas that offer a variety of playtime activities demonstrate better motor development. [3]
- Vegetable gardening among students at school helps mitigate a sedentary lifestyle among children. [4]

RECOMMENDATIONS

- Create attractive outdoor areas with a variety of playtime activities and games, and make sure it is large enough so that children are not always in each other's way.
- Integrate the vegetation with the other elements in the schoolyard, so it is not mere decoration.
- Ensure that the greenery can cope with the level of play in the playground.
- Vegetable gardens can capture children's interest in nature.
- Create a challenging but safe outdoor area. Do not use any poisonous plants, and keep safety requirements in mind.

Sources:

1. *M Söderström M, Boldemann C, Sahlin U, Mårtensson F., Raustorp A., Blennow M, 2013 The quality of the outdoor environment influences childrens health – a cross-sectional study of preschools, Acta Pædiatrica 102, pp. 83–91.*
2. *Pagels P, Raustorp A, Ponce de Leon A, Mårtensson F, Kylin M., Boldemann C. 2014 A repeated measurement study investigating the impact of school outdoor environment upon physical activity across ages and seasons in Swedish second, fifth and eighth graders in BMC Public Health201414:803.*
3. *Fjørtoft, I. 2004 "Landscape as Playscape: The Effects of. Natural Environments on Children's Play and Motor Development in Children, Youth and Environments 14(2).*
4. *Kruid, S., 2016. Systematic literature review: school and community garden interventions in children. BSc-Thesis Wageningen University.*

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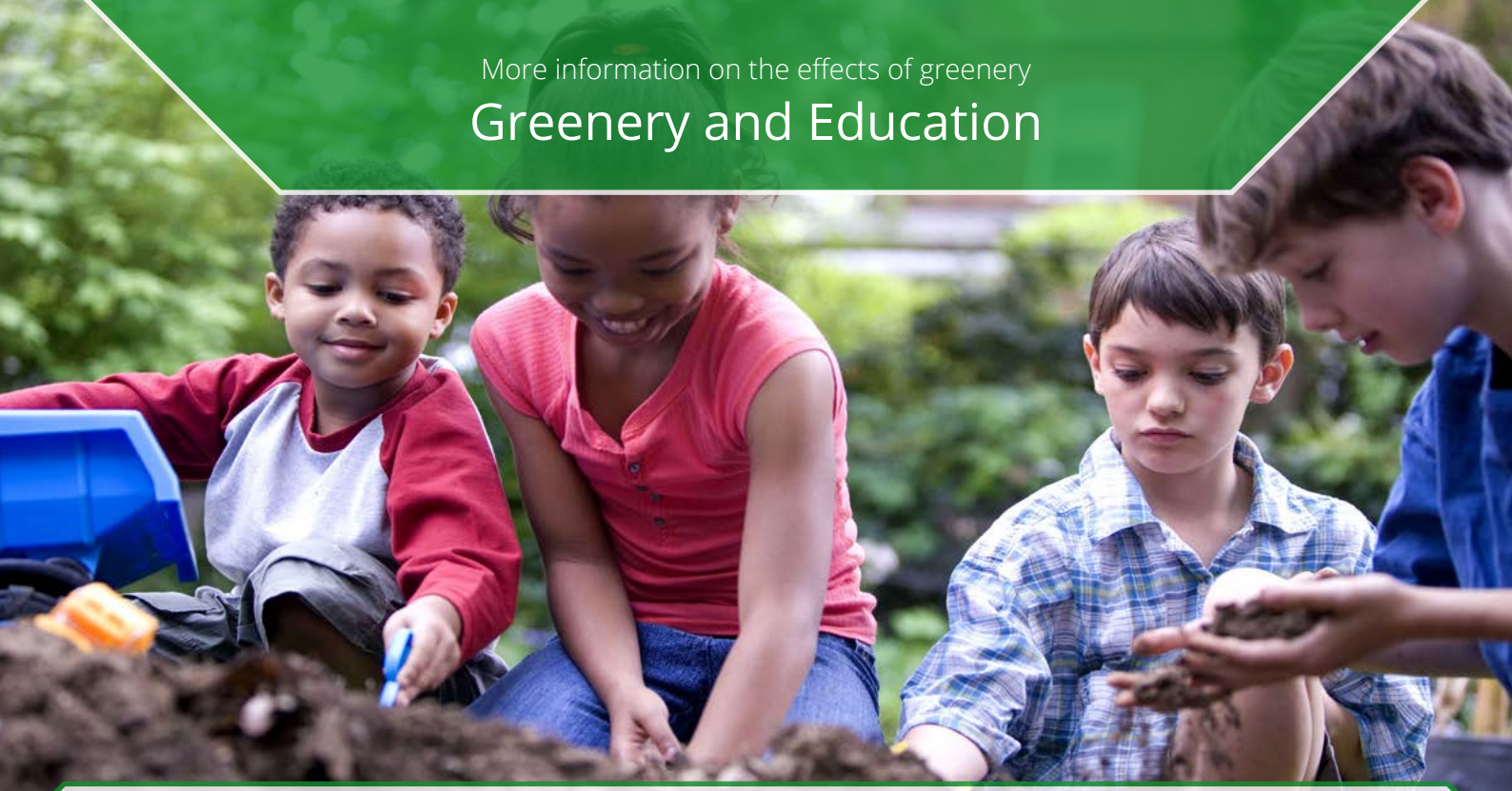

SOCIAL CLIMATE

In addition to children's cognitive and physical performance, their socio-emotional well-being and development are also important factors. These include matters such as self-confidence, empathy, respectful behaviour, helping one another and learning to cooperate. The social climate is an important element in this regard, and the schoolyard is no exception.

HOW GREENERY WORKS

- A well-designed green playground that is attractive and functional can contribute to improving the outdoor social climate, and children's well-being in general. [1]
- School vegetable gardens, for example, can increase children's intake of fruit and vegetables and improve levels of 'green literacy'. [2]
- The influence of greenery on young students can have a long-term positive effect.
- Some of the benefits (e.g. of keeping a vegetable garden) can also filter up to the parents.

RECOMMENDATIONS

- Create a diverse range of playtime activities (something for everyone), as well as places where children can go to rest and/or get away from it all.
- Include proper outdoor furniture, and covered spaces where necessary.
- Adequate open spaces encourage team sports, such as a range of ball sports.
- Including play equipment will encourage children to play together.

Sources:

1. *de Vries, S., Langers, F., Donders, J. L., Willeboer, M. T., & Van den Berg, A. E. (2013). Meer groen op het schoolplein: een interventiestudie [More greenery in schoolyards: an intervention study (No. 2474). Alterra Wageningen UR.*
2. *Kruid, S., 2016. Systematic literature review: school and community garden interventions in children. BSc-Thesis Wageningen University.*

FURTHER INFORMATION

There are many real-life applications that illustrate and demonstrate the added value of vegetation.
Useful sources of information include:

www.thegreencity.com
www.wur.nl
www.royalfloraholland.com
www.groenkennisnet.nl

Specific questions on topics such as reference projects, research results, etc. can be sent directly to **joop.spijker@wur.nl**.

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Giving greenery its due

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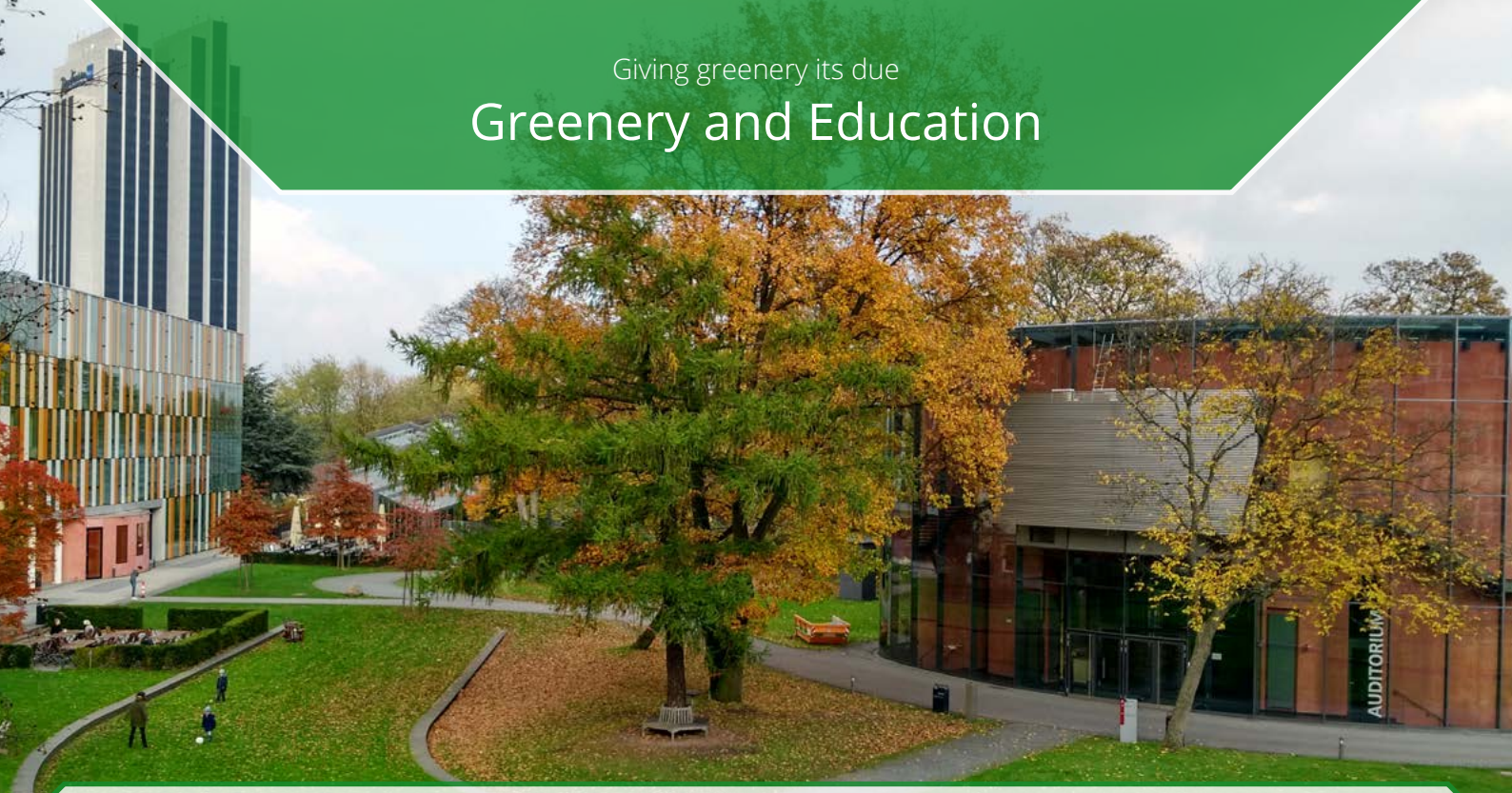

Due to its many positive benefits, greenery deserves a prime position in planning and budgeting processes. In consultation with potential and existing clients, the tips below can help suppliers of vegetation to give greenery its due in and around childcare centres, schools and campuses.

STAKEHOLDERS

- All projects involve a wide variety of stakeholders: users, investors, initiators, and many others who influence the decision-making process.
- Getting to know these groups will allow suppliers of vegetation (potentially in conjunction with partners) to eliminate possible objections and customise greenery to suit their needs.

TIPS

- Identify the relevant criteria – in addition to the desired appearance, also consider matters such as the available space, budget, and the social environment. Use this information to educate the stakeholders about the benefits of greenery, as provided on this fact sheet and in the list of references.
- Eliminate risks by providing comprehensive information on the initial investments required, including setup costs (possibly do this in collaboration with other businesses or an architect).
- Also provide information on maintenance methods, frequency and costs. Help mitigate risks (e.g. by providing a maintenance plan), and do not forget simple matters such as watering!
- Inform the target groups on the new possibilities offered by greenery, such as learning about nature and nutrition.
- Involve other stakeholders (such as teachers and students) either directly or indirectly in decision-making, application and implementation processes.
- Estimate the age of the user group, identify what is important to them, and summarise the benefits of greenery that meet these needs.

CREATE DEMAND

- The earlier the vegetation supplier takes on a role in the project, the more influence they can exert on the priority of greenery, and therefore on the available budget.
- Users (teachers, students/children or their parents) can be approached directly, or via bodies such as representative or student councils.
- Approaching an architect or project developer pro-actively and on time can achieve the same result.

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