Valuing Trees:
What Is Nature Worth?

national tree day

PLANET ARK TOYOTA

A research report commissioned by Planet Ark and sponsored by Toyota Australia.

About This Report

In the lead up to National Tree Day over the last three years, Planet Ark has released the research reports focusing on Australians' contact with nature and outdoor play / recreation. The reports include:

- 2011 - *Climbing Trees: Getting Aussie Kids Back Outdoors* highlighted the dramatic changes in children's play and interaction with nature that have taken place in just one generation.
- 2012 - *Planting Trees: Just What The Doctor Ordered* included a comprehensive summary of the intellectual, psychological, physical, and mental health benefits of contact with nature for children and Australians parents' understanding of these benefits.
- 2013 - *Missing Trees: The Inside Story of an Outdoor Nation* explored Australians' current relationship with the backyard and the great outdoors in general.

For the most part, these reports focused on the health and wellbeing benefits of contact with nature for children. This year's report, Valuing Trees: What is Nature Worth?, takes a broader focus and looks at the economic, environmental, health, and social benefits of nature in the workplace, at home, in neighbourhoods, and in schools.

The report includes the results of an independent survey commissioned by Planet Ark and conducted by research consultancy Pollinate in March 2014. A nationally representative sample of one thousand Australians aged 14-64 years participated in the online survey. In addition to the survey results, the Valuing Trees report draws together the findings of a wide range of relevant international and local research.

Planet Ark Environmental Foundation

Planet Ark is an Australian not-for-profit organisation with a vision of a world where people live in balance with nature. We were established in 1992, with the aim of creating positive environmental actions that everyone can undertake.

More than 20 million trees, shrubs and grasses have been planted since Tree Day began in 1996. Each year, over 200,000 people get into nature as part of National Tree Day.

Toyota

In 2014, Toyota is celebrating its 15th continuous year of involvement with Planet Ark and National Tree Day.

Actively engaged in a wide variety of global programs that aim to improve the environment, Toyota provides on-ground support for National Tree Day at local community tree planting sites Australia wide.

Mobilising its national dealer network, as well as its roster of ambassadors who appear at National Tree Day and Schools Tree Day planting events, Toyota is able to give something back to local Australian communities, encouraging nature care as part of its genuine global commitment to sustainability.

Social Soup

The independent survey was made possible through the support of Social Soup.

"Social Soup is an influential community of thousands and thousands of people who love loads of different things. We like to talk about brands, products and new ideas. We discuss. Test. Try. And most of all we share it with our friends. Online and in the real world. We're Australia's leading social innovations community. The most influential way to develop and launch new ideas. Real results from real people sharing real experiences."

Acknowledgements

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PLANET ARK TOYOTA SOCIAL SOUP

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INTRODUCTION

Many of us are instinctively drawn to natural settings – parks, gardens, rivers, mountains, the ocean, and even the backyard – both because we appreciate their beauty and because we simply feel better there. While we may appreciate some of the aesthetic and practical benefits of trees and plants, such as the colour and life they bring to our homes and workplaces, the privacy they offer, and the relief they provide from the intense summer sun, most of us are probably unaware of the vast array of financial, environmental, health, and social benefits provided by trees and nature. Most of us, too, would rarely, if ever, reflect on what nature is worth to us.

Assigning a value to nature

We live in a world that mostly assigns value to things by putting a price on them. As a result, it is easy to overlook and undervalue the things we cannot put a price on. Many of the less tangible benefits provided by trees, plants, and other forms of nature fall into this category, including:

- Their positive impact on our health, productivity, and ability to learn;
- The ecological services they provide, such as air and water filtration and the reduction of temperatures; and
- Their ability to help mitigate climate change.

This, combined with the fact that we now spend the vast majority of our time indoors, often in front of a screen, means it is all too easy for individuals and society to view nature as something we can live without. In turn, this leads to the tendency to dispense with, or mismanage, nature in ways that are detrimental, not only to the planet, but also to our own health and wellbeing, and indeed, to our long-term survival as a species.

Slowly though, things are changing. As the world faces the huge challenges of population growth, environmental destruction, and climate change, a growing body of research is revealing the many ways nature benefits individuals, communities, the economy, and the environment. Scientific and technological advances are now allowing us to put a price tag on an increasing number of these benefits.

Urban forests

Across the world, more and more cities are taking this knowledge on board and introducing urban forestry strategies to help them mitigate the impacts of climate change and growing populations, and maintain and improve their liveability. In Australia, for example, the City of Sydney aims to increase the city's average total canopy cover from its current level of just over 15% to 27% by 20501, while the City of Melbourne is working to increase its canopy cover from 22% to 40% by 20402. The urban forest strategies of both cities also focus on increasing species diversity.

Nearly 4 out of 5 Australians agree that "green" neighbourhoods are better places for children to grow up than those with little nature.

This report

The main goal of Planet Ark's Valuing Nature Survey, conducted by Pollinate in March this year, was to find how much Australians value nature at work, at home, in their neighbourhoods, and in their children's schools. This report, Valuing Trees: What is Nature Worth?, presents the results of this survey, and outlines the findings of national and international research that shines a light on the many benefits of nature in these settings, as well as various studies that have aimed to put a financial value on some of these benefits.

KEY FINDINGS OF THE VALUING NATURE SURVEY

In March 2014, Planet Ark commissioned research consultancy Pollinate to conduct an independent online survey to explore Australians' attitudes, behaviours, and preferences in regards to nature at work, at home, in their neighbourhood, and at school. The survey also aimed to find out how much Australians value being able to connect with nature in these settings. A nationally representative sample of one thousand Australians aged 14-64 years participated in the survey. Outlined below are the key findings.

Valuing nature at work

- A quarter of Australian indoor workers (25%) do not take breaks – even short ones – outside in a natural setting.
- Around 7 in 10 indoor workers (69%) would like to spend more of their working day outside in a natural setting.
- When asked what was stopping them from spending more time outdoors, the most commonly chosen barrier from a list of ten, was that they were too busy (selected by 40% of respondents).
- Only 1 in 10 indoor workers (10%) prefer to be inside rather than outside during breaks.
- The indoor workers who do spend time outside in a natural setting during their working day, whether to take a short break, eat a meal or exercise, do so every day, demonstrating its importance to them.
- Nearly two-thirds of indoor workers (63%) would prefer a job in a workplace where they can see natural elements like indoor pot plants or a view of trees or a garden. However, from their primary workspace:
  - Half of indoor workers (50%) cannot see a window that leads to the outside;
  - Over half of indoor workers (52%) cannot see the sky;
  - Around 1 in 4 indoor workers (26%) cannot see live plants or flower arrangements;
  - Nearly half of indoor workers (45%) cannot see a tree;
  - Around 1 in 5 indoor workers (21%) cannot see any indoor or outdoor natural elements from their workspace.
  - Around 4 in 5 indoor workers (79%) cannot see any artwork, such as photographs or paintings, depicting natural scenes.
- Assuming a base annual salary of $70,000, Australians would be willing to give up an average of $3,700 (5% of base salary) in order to connect with nature regularly during their working day. More than 1 in 5 Australians (22%) would be willing to give up $10,000 or more.
- People who are very or extremely concerned about the environment would give up more than the average – up to 6.5% of the nominated base salary – while older people, specifically "empty nesters" and those aged 50-64 years – would sacrifice an average of around 7% of a $70,000 annual salary.
- Survey respondents were asked to think about their ideal workplace and rank how important a number of workplace features are to them:
  - More than half of Australians (55%) consider having a window with views of nature to be important;
  - More than half of Australians (54%) view having an outdoor break area with natural elements to be important;
  - Australians consider having a window with views of nature and an outdoor break area to be as important as having easy access to shops and banks;
  - One in three people (31%) consider having a window with views of nature to be even more important than having good cafes in the area;
  - Nearly 1 in 2 people (47%) consider having an indoor break area with plants and views of nature to be important;
  - Only around one quarter of Australians (28%) think having easy access to a gym or pool is an important feature of their ideal workplace.
- Around two-thirds of Australian workers (64%) agree that having regular contact with nature at work would reduce their stress levels.
- Around two-thirds of Australian workers (65%) agree that having regular contact with nature at work would make them happier.
- Around 3 in 5 Australian workers (61%) agree that having regular contact with nature at work would

make them feel more positive about going to work and doing their job.

- Nearly 3 in 5 Australian workers (59%) agree that Australian employers should focus more on providing opportunities for employees to have regular contact with nature.

Valuing nature at home

- Nearly 4 out of 5 Australians (78%) would prefer to live in a home with many natural elements, such as trees, plants, and a garden, over one that does not have these features.
- Assuming a base house cost of $500,000, Australians would be willing to pay an average of $35,000 more (about 7% of base cost) for a home in a green neighbourhood than for the same kind of home in an area with little surrounding nature. Around one third of Australians (34%) would pay an extra $100,000 (20% of base cost), while 15% of people would pay an extra $120,000 or more.
- Three-quarters of Australians (73%) report that a backyard is an important feature of their ideal home. Out of 14 different natural and non-natural home features, a backyard is the one considered by Australians to be the most important.
- When asked to consider their ideal home and rank the importance of 14 natural and non-natural features to them, Australians rated having a home with a backyard and living in a "green" neighbourhood with many trees, parks, and gardens even higher than:
  - being close to work;
  - having easy access to public transport; and
  - having good shops or a shopping centre nearby.
- Nearly 3 in 5 Australians (57%) say that having a park within 5-10 minutes walk of their home is important to them, while a similar proportion (56%) report that having views of nature, such as a park, bushland, or paddocks, is important.
- Compared to the general population, the preference for a "green" home is higher among women, people with children, Australians who are concerned about the environment, and people in the later stages of their life, specifically those with older children and "empty nesters".
- More than two-thirds of Australians (68%) agree that living in a neighbourhood with lots of trees, gardens, and parks would reduce their stress levels.
- Two-thirds of Australians (66%) agree they would be more likely to do outdoor exercise if they lived in a green neighbourhood.
- Nearly 3 out of 5 Australians (56%) value having neighbours with well-kept gardens featuring trees and plants.
- More than two-thirds of Australians (68%) agree that neighbourhoods with lots of trees, gardens, and parks feel safer and more welcoming than those without nature.
- Around 4 out of 5 Australians (78%) agree that nature-filled neighbourhoods are better places for children to grow up.

Valuing nature at school

- When asked to consider the ideal school for their child, three-quarters of Australian parents (79%) rated natural school grounds with real grass, trees, and gardens as important.
- Parents consider green school grounds to be as important as good academic outcomes and reputation.
- Parents rate spacious school grounds and excursions to natural places as highly as modern classroom facilities and closeness to home.

Photo by Sandra Mobney.

Australians consider living in a nature-filled neighbourhood to be even more important than being close to work, having easy access to public transport, and having good shops nearby.

VALUING NATURE AT WORK

Planet Ark's Valuing Nature Survey was designed to get an understanding of how much Australians value working in a greener and more natural workplace and the opportunity to connect with nature during work hours. It also examined the level of interaction that Australian indoor workers have with nature and whether they are happy with that interaction.

The changing nature of work

Beginning in the 18th Century, the Industrial Revolution ushered in significant and rapid changes in the way people lived and worked. The revolution sparked the creation of factories, which saw large numbers of workers move to cities in search of employment. In places like Britain, Western Europe, and America, agrarian societies, in which people relied on farming for their survival, began to decline. With the growth in manufacturing and urbanisation, people began spending more and more time indoors and became increasingly disconnected from the natural world.

The growth of urbanisation has continued unabated into the 21st Century. The World Health Organisation estimates that by 2050, 7 out of 10 people will live in a city[3]. In Australia, over two-thirds of the population currently live in capital cities and other major cities[4]. The increasing urbanisation of Australia has coincided with significant changes in the nature of work in this country. In 1911, the most common occupations for Australian men were farmer and farm labourer[5]. Today, indoor workers dominate, with retail and health care / social assistance now the biggest industries by employment[6]. Technological advancements and the growth of an information-based economy has resulted in growing numbers of "knowledge workers", a term coined by Peter Drucker in the 1960s to describe workers who are paid to acquire, analyse, and manipulate information[7]. Knowledge workers largely work indoors. In 2004, the Australian Bureau of Statistics (ABS) found that knowledge workers made up nearly 40% of the Australian workforce, up from around 28% in 1997[8].

The move to indoor work, and the fact that Australians work some of the longest full-time hours in the world[9], mean the environment we work in can have a significant impact on our performance and productivity, our attitude towards our job, and our overall health and wellbeing.

Can't stop, too busy

Results from the Valuing Nature survey show that many workers would like to spend more time outside during their working day but struggle to find the time. Indoor workers were asked how often in a typical working week they undertook various activities outdoors in a natural setting and whether they were happy with the amount of time they spent outside:

- A quarter of indoor workers (25%) said they do not take breaks – even short ones – outside in a natural setting (Figure 2);
- Around 7 in 10 indoor workers (69%) said they would like to spend more work-time outside (Figure 1).

Around 7 in 10 indoor workers would like to spend more time outside in a natural setting during their working day.

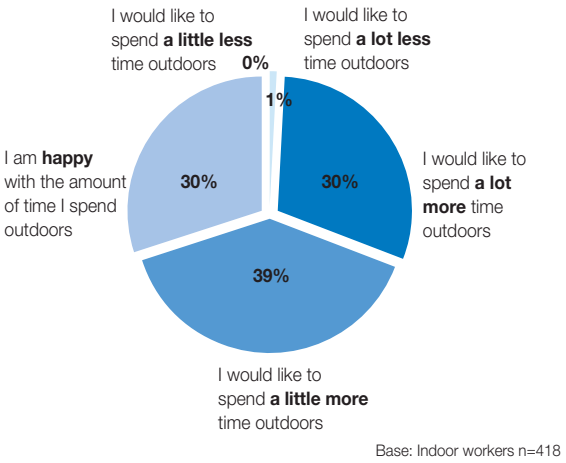
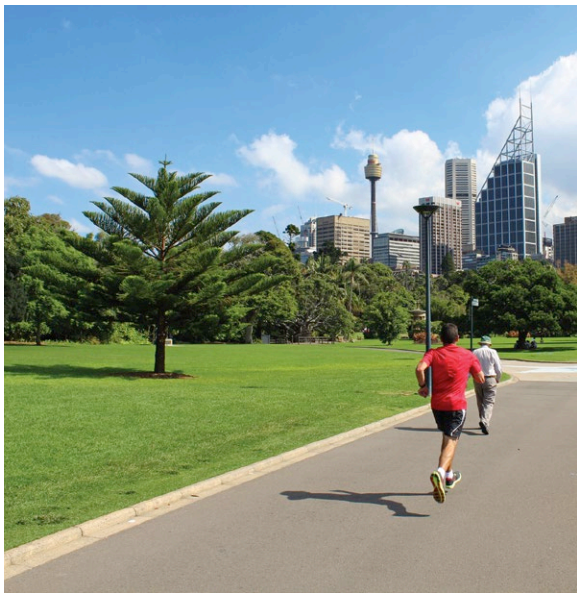


Figure 1. Preferences of indoor workers for time spent outside in natural settings during work hours.



A quarter of Australian indoor workers do not take any breaks outside in a natural setting during their working day.

Interestingly, the results show that those who do spend time outside in a natural setting during their working day, whether to take a short break, eat a meal, or exercise, do so every day, demonstrating its importance to them.

When asked what was stopping them from spending more time outdoors, the most commonly chosen reason (selected by 2 in 5 respondents) was that they were too busy (Figure 2). Only 1 in 10 respondents said they prefer to be inside rather than outside during breaks (Figure 2).

These findings support research commissioned by Beyond Blue and The Australia Institute in 2013[10], which found that 3.8 million Australian workers regularly do not take a lunch break. Half of these workers said they are too busy to take a lunch break and nearly 3 in 4 people (72%) said they often eat lunch at their desk, cut lunch short, or take their lunch break in the mid-afternoon. Four out of five respondents (79%) believe that taking a break makes them more productive, but about 1 in 4 (26%) said they are not able, or not usually able, to take a short break to clear their head if they are finding it difficult to concentrate.

The cost of a stressed out workforce

Work-related stress is a serious and costly problem in Australian workplaces. A 2013 survey by health insurance company Medibank[11] found that 85% of Australians experience severe stress at work, with half of full-time workers feeling seriously pressured most weeks of the year. It also found that 40% of employees feel their work negatively impacts on their mental health. A recent Australian Psychological Society study[12] found that working Australians report significantly lower overall workplace wellbeing compared with workers in Europe.

The Medibank study found that 15% of workers take sick days at least every month due to stress, resulting in more than 20 million days off per year. Work-related stress can often result in not only absenteeism, but also presenteeism, where an employee comes to work but is not fully functioning. Medibank estimated that, in 2008,

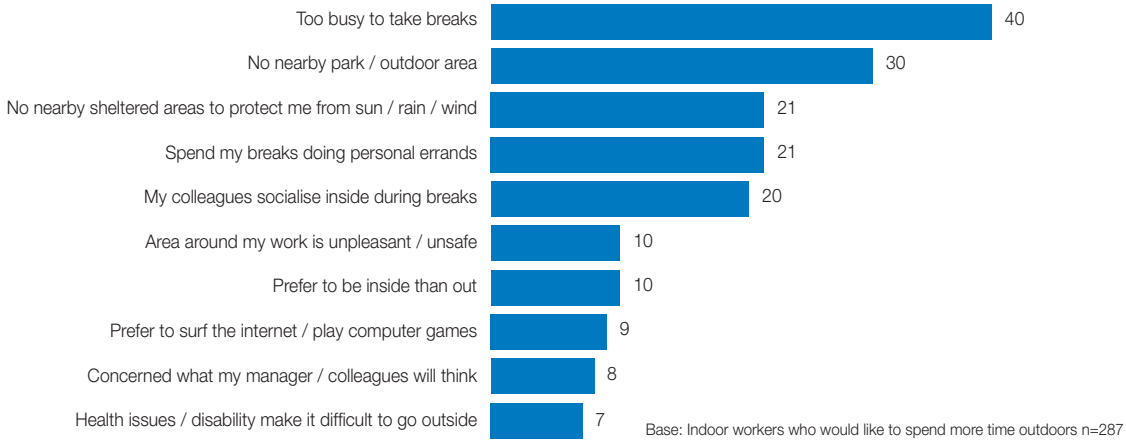
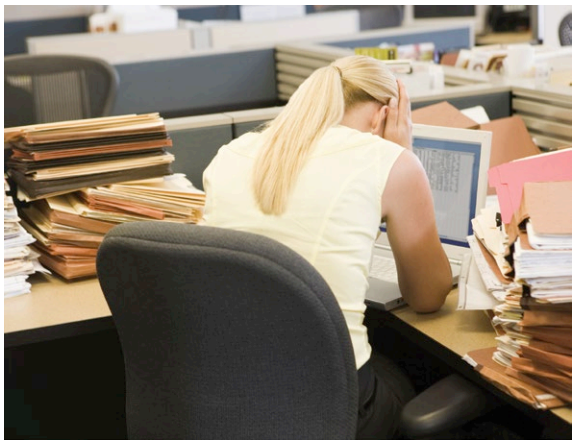


Figure 2. Percentage of the indoor workers wanting to spend more time outside in natural settings who said the barriers listed prevent them from doing so.



A recent Medibank study found that half of Australia's full-time workers feel seriously pressured at work most weeks of the year.

absenteeism and presenteeism resulting from workplace stress cost the Australian economy A$14.81 billion per year and directly cost employers A$10.11 billion per year[13]. These figures do not include the hidden cost of re-staffing and re-skilling, when stress results in staff turnover.

An unnatural place to work

In Planet Ark's Valuing Nature survey, respondents who work indoors were provided with a list of indoor and outdoor natural features and asked which ones they could see from their primary workspace (Figure 3):

- Half of indoor workers (50%) cannot see a window that leads to the outside;
- Over half (52%) cannot see the sky;
- Around 1 in 4 (26%) cannot see live plants or flower arrangements;
- Nearly half (45%) cannot see a tree;
- Around 1 in 5 (21%) cannot see any indoor or outdoor natural elements from their workspace.

Half of Australia's indoor workers cannot see a window that leads to the outside and over half cannot see the sky.

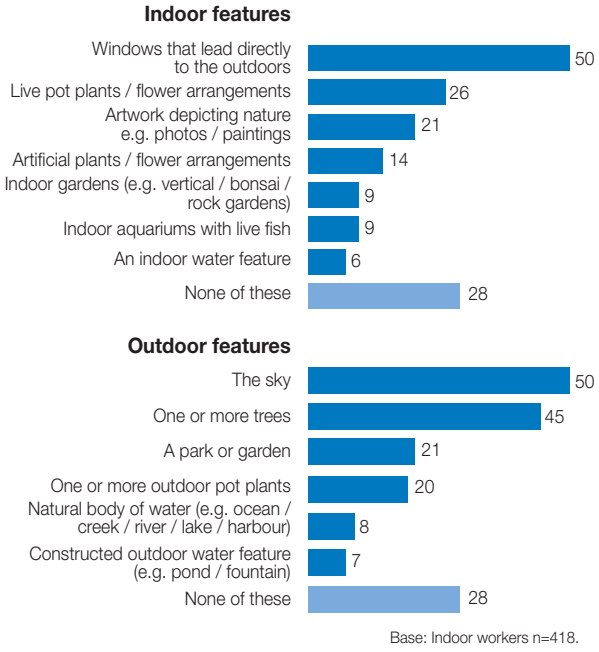


Figure 3. Percentage of indoor workers who can see the listed indoor and outdoor natural features when they are at their primary workspace.

However, when asked what type of work environment they would prefer, nearly two-thirds of indoor workers (63%) said they would prefer a job in a workplace where they can see natural elements like indoor pot plants or a view of trees or a garden (Figure 4). Nearly 3 in 5 (59%) Australian workers agree that Australian employers should focus more on providing opportunities for employees to have regular contact with nature (Figure 7).

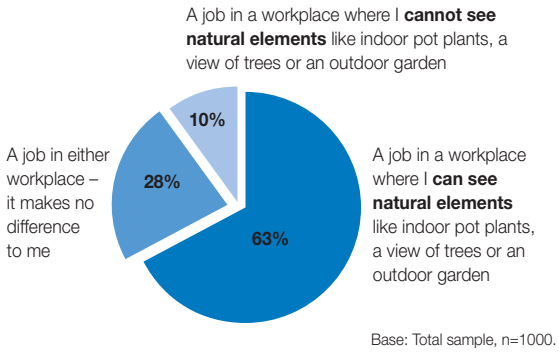


Figure 4. Percentage of Australians who would prefer a job in the different workplaces listed.

What is nature at work worth to Australians?

One of the key aims of Valuing Nature Survey was to find out how much being able to connect with nature at work is worth to Australians. The survey measured how much salary Australians would be willing to sacrifice in order to have regular contact with nature. Assuming a base annual salary of $70,000, results showed that Australians would be willing to give up an average of $3,700 (5% of base salary) in order to connect with nature regularly during their working day (Figure 5). More than 1 in 5 Australians (22%) would be willing to give up $10,000 or more (Figure 5). Perhaps unsurprisingly, those who are very or extremely concerned about the environment would give up more than the average – up to 6.5% of the nominated base salary – while older people, specifically "empty nesters" and those aged 50-64 years – would sacrifice an average of around 7% of a $70,000 annual salary.

Australians would be willing to give up an average of $3,700* in salary to get a regular dose of nature during their working day. More than 1 in 5 people would be willing to give up $10,000 or more*.

***Assuming a base annual salary of $70,000.**

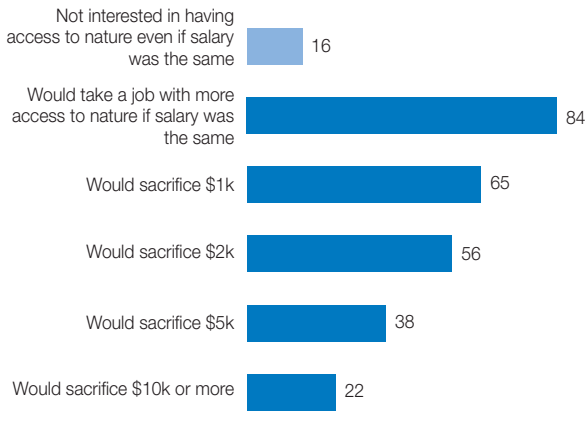


Figure 5. Percentage of total sample who would be prepared give up the salary amounts listed* to take a job that offered them regular access to nature.

***Assuming a base annual salary of $70,000.**

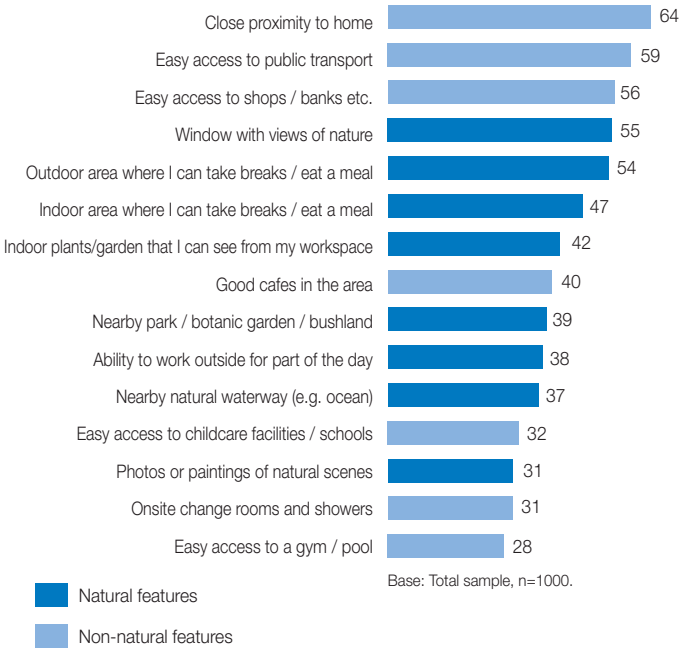


Figure 6. Percentage of total sample who consider the listed features to be important qualities of their ideal workplace.

Survey respondents were also asked to think about their ideal workplace and rank how important a number of workplace features are to them (Figure 6). The survey found that:

- More than half of Australians (55%) consider having a window with views of nature to be important;
- More than half of Australians (54%) view having an outdoor break area to be important, while nearly 1 in 2 (47%) consider having an indoor break area with plants and views of nature to be important;
- Australians consider having a window with views of nature and an outdoor break area to be as important as having easy access to shops and banks;
- One in three people (31%) consider having a window with views of nature to be even more important than having good cafes in the area;
- Only around a quarter of Australians (28%) think having easy access to a gym or pool is an important feature of their ideal workplace.

Having a window with views of nature and an outdoor break is as important to working Australians as having easy access to banks and shops.

1 in 3 Australians consider having a window with views of nature at work to be even more important than having good cafes in the area.

These results clearly indicate that Australians value having access to nature at work. They also suggest that employers wanting to introduce workplace health programs and staff benefits should consider "greening" their workplace and offering outdoor activities like regular lunches or walks in the park, in addition to, or instead of, things like gym memberships.

The importance of a good working environment to employees has been highlighted in a number of international studies. A British Council for Offices' report included a quote from a survey carried out for a large commercial property developer, which suggested that as many as 45% of employees would change their job for one with a better working environment, even if their role, salary, and benefits remained the same[14]. A US study found that nearly three quarters of workers (73%) consider office surroundings to be important when weighing up potential employers[15].

The impact of poor working environments

In a large US survey[16], 9 out of 10 respondents admitted their attitude about work is affected by the quality of their workplace environment. The nicer the environment, the better they felt about their job. In a similar study of full-time workers in the US[17], 1 in 4 respondents described their workplaces as cramped and noisy with no natural light, greenery, or ventilation. It found that three quarters (75%) of those who worked in a gloomy or depressing work environment had taken at least one sick day in the previous year compared to only 60% of employees who worked in a stimulating or relaxing environment.

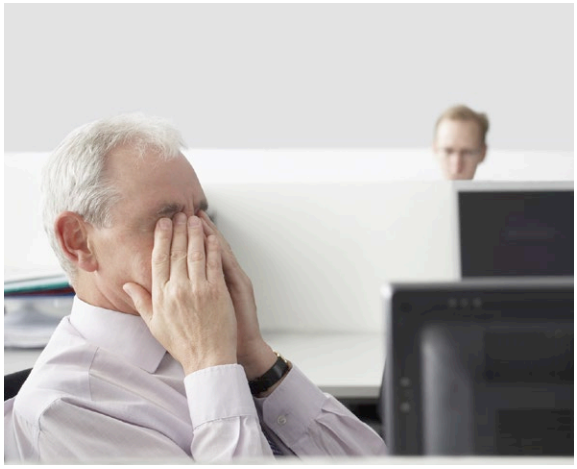
In the US, 75% of people who worked in a gloomy or depressing work environment had taken at least one sick day in the previous year compared to only 60% who worked in a stimulating or relaxing environment.

One of the most serious and widespread issues affecting indoor work environments is poor air quality. Generally, air pollution is worse indoors than outdoors[18]. In a typical office, workers are exposed to a cocktail of volatile organic compounds (VOCs), such as formaldehyde, benzene, toluene, and xylene, that are emitted by building materials, furniture, carpets, paints, coatings, sealants, office equipment, and consumer products. Carbon dioxide (CO2), mainly resulting from human respiration, is another major indoor pollutant, resulting in "stuffy" rooms when levels are high.

Poor indoor air quality is a major contributor to "Sick Building Syndrome" (SBS). SBS describes a range of non-specific symptoms that affect a significant number of building occupants but fade when the occupants leave the building[19]. SBS is mainly associated with office buildings and other non-industrial buildings like schools. Symptoms include:

- irritated eyes, nose, throat, and skin;
- general health problems like headaches, mental fatigue, reduced capacity to concentrate, dizziness, and nausea;
- hypersensitivity reactions, such as running nose or eyes, or asthma-like symptoms; and
- respiratory issues.

Air pollution is generally worse inside buildings than outside.



Poor indoor air quality can cause a range of health issues, including irritated eyes, nose or throat, respiratory issues, mental fatigue, headaches, and nausea.

In 1998, the CSIRO estimated that, based on data from US studies, indoor air pollution could be costing Australia A$12 billion per year[20].

A committee of the World Health Organization (WHO) estimated that as many as 30% of buildings in the developed world may have problems that can lead to occupant complaints and illness[21]. A Harvard School of Public Health survey of 56 US buildings[22] found that nearly a quarter of office workers reported two or more frequent SBS symptoms that improved when they were away from the workplace. Based on this figure, the researchers estimated that, in 2000, 15 million workers in the US were frequently affected by at least two SBS symptoms and the annual cost of SBS in the US was US$60 billion.

The link between work environments and productivity

Staff salaries and benefits are the biggest cost for most businesses. As such, even a small improvement in employee productivity will have a major impact on an organisation's bottom line, whether it is a for-profit business, a not for profit organisation, or a government-funded institution like a school or hospital. Although worker productivity can be difficult to define and measure, and can be impacted by a wide range of factors, considerable research now exists showing that improving indoor environments for workers can lead to increased performance and productivity.

Improving indoor work environments can lead to increased staff performance and productivity.

In a US workplace survey[23], 90% of respondents said that better workplace design and layout could result in better overall employee performance, and 88% of workers believed their working environment was very important to their sense of job satisfaction. Nearly half of respondents (49%) agreed they would be willing to work an extra hour a day if they had a better working environment.

A recent meta-analysis of 75 worldwide academic studies found that environmental conditions such as temperature, lighting, ventilation, and noise have a 1-3.5% impact on occupant performance, and that office refurbishments improve performance by 4%-8%[24]. Other studies indicate that the physical office environment may account for changes in employee productivity of 5%-15%[25]. Focusing on air quality alone, a Danish study found that for every 10% reduction in workers reporting dissatisfaction with air quality, there was a 1.5% rise in performance in text typing, addition, and proofreading activities[26].

Various Australian studies have found that employees working in green buildings are more satisfied and productive than employees in non-green buildings. Green buildings in this instance are offices that have a Green Star certification in accordance with the rating system of the Green Building Council Australia (GBCA). These workplaces differ from non-green workplaces in a number of ways, for example, in their fresh air intake, amount of daylight, and use of non-toxic materials[27]. A number of pre- and post-occupancy studies have shown improvements in perceived productivity of up to 13% after employees have moved to a new green building or after a workplace has been refurbished to a high Green Star level[28, 29, 30]. In one refurbished building in Melbourne, a tenant also reported a 44% drop in the monthly average cost of sick leave[31].

Photo courtesy of Ambius Indoor Plants.

Australian studies have found that employees working in green buildings are more satisfied and productive than employees in non-green buildings.

In 2009, an Australian study comparing ten green office buildings (Green Star-rated in accordance with GBCA standards) with 11 non-green office buildings[32] found that green workplace environments scored higher employee satisfaction levels in the areas of thermal comfort, natural light, views, air quality, and individual controllability. Employees in green buildings also experienced fewer instances of asthma, headache, muscular pain, fatigue, and poor concentration.

For most organisations, only a small increase in staff productivity is needed to pay for the cost of improving work environments.

For most businesses, the costs of salaries and benefits far outweigh the costs of providing and maintaining a workplace. Therefore, only a small increase in staff productivity is needed to pay for a much larger percentage increase in building costs, and the payback time is generally quite short[33]. Changes aimed at improving indoor environment quality (IEQ) in a workplace do not always have to be costly. A simple change, such as introducing more plants and other natural elements into the workplace, can significantly improve IEQ with minimal outlay.

Greening the grey: The benefits of plants in the workplace

While plants have long been incorporated into office buildings for their aesthetic appeal, research has shown that having plants and other natural elements in a building, and providing opportunities for workers to connect with nature both inside and outside the workplace, can boost an organisation's outcomes by improving the physical and mental health of employees, increasing productivity, and reducing operational costs.

Plants improve indoor air quality and reduce worker illnesses

With their large surface area and ability to exchange water and gases with their surroundings, plants can tackle a multitude of indoor environment issues. Indoor plants are essentially living air conditioning and purification systems, as a number of studies have shown:

- Some of the earliest research on the ability of plants to purify air was carried out at NASA's Stennis Space Centre in the 1970s[36]. The researchers found that, upon entering a tightly sealed building constructed entirely of synthetic materials, participants experienced SBS symptoms, such as burning

Reaping the rewards of a better work environment

Some employers in Australia are recognising the financial and other benefits of providing staff with healthy and productive work environments. In late 2014, health insurer **Medibank Private** will move its Melbourne staff from six older buildings to one new tower at Docklands, a building Medibank describes as being "hard wired for health"[34]. About 10% of the building's facade will be covered by plants, which will provide the building with extra shade and leafy views for staff. Much of the building's return on investment is expected to come from improved productivity and efficiencies resulting from staff who are physically and mentally healthy, as well as from a well-designed workspace.

Also in Melbourne, building services and sustainability consulting company **Umow Lai** focused heavily on providing a better working environment for staff when it was fitting out its new building in 2006[35]. The interior of the building, which achieved a 6 Star Green Star – Office Interiors rating, includes five bio-filtration walls covered in plants designed to break down VOCs from the air, improving its quality before being re-circulated back into the office. Other features include: openable windows; large balconies that staff can access during breaks; energy recovery ventilators that boost outside air volumes, thus improving indoor air quality; local control of air conditioning; use of materials with low VOC content; and a bike storage facility with showers and change rooms. Independently conducted pre- and post-occupancy surveys found a strong increase in satisfaction among staff for the workspace and indoor environment quality, along with a perceived productivity increase of 13%.

eyes and respiratory difficulties. After installing a large number of commonly used houseplants in the building, the VOCs and the participants' SBS symptoms disappeared.

- Commonly used indoor potted-plant species, such as Peace Lily and Kentia Palm, have been found to eliminate repeated high doses of VOCs in 24 hours in a closed chamber with no ventilation[37].

Three floor-standing pot plants have been found to reduce the levels of VOCs in a standard-sized office by up to 75%.

- Australian office studies have found that three floor-standing pot plants can reduce the levels of VOCs in a standard-sized office by 75%[38] and that potted plants can reduce CO2 levels by 25% and carbon monoxide (CO) levels by 90%[39].
- A Norwegian study of 59 office workers[40] found that introducing plants to the office resulted in a:
  - 30% drop in fatigue;
  - 20% drop in headaches;
  - 23% drop in dry / hoarse throat;
  - 37% drop in coughing; and
  - 23% drop in dry facial skin.
- A further 5-year study in Norway[41] found that introducing plants and full spectrum lighting to a hospital resulted in a 25% decrease in overall health complaints by staff. Eleven months after the plants and lighting improvements were introduced, health and discomfort complaints remained at a lower level than before the intervention[42].

Introducing plants and full-spectrum lighting into a Norwegian hospital resulted in a 25% reduction in overall staff health complaints.

- Tests conducted in the US and UK have shown that plants can increase humidity levels in an unventilated room by up to 15% and in a ventilated room by 3-5%[43]. The humidifying quality of plants is important because many indoor environments suffer from low air humidity, which can result in issues like dry throat and dry skin, and increase the risk of respiratory illnesses. Plant species with a high transpiration rate increase humidity the most.

Plants improve productivity and boost creativity

Good evidence now exists showing an association between plants in a workplace and improved employee performance and productivity:

- In the UK, people working in "enriched" environments (those decorated with plants and pictures) were found to be 17% more productive than those working in "lean" environments that were bare and functional[44].

Photo courtesy of Smack Bang Designs.

People working in environments decorated with plants and pictures have been found to be 17% more productive than those in bare and functional environments.

- Dutch employees with plants in their work area were found to be more productive and better able to concentrate than employees with no plants present[45]. They also rated their wellbeing and the quality of their working environment more favourably. The strongest link between the presence of plants and improved productivity was found in employees who worked at computer terminals for more than four hours per day.

The indoor workers who get the biggest boost in productivity from plants in the workplace are those who spend more than four hours per day at computer terminals.

- In the US, study participants in a windowless computer room with plants achieved a 12% faster reaction time on a simple, timed activity than participants in a similar room without plants[46]. The participants with plants present also reported feeling more attentive after they completed the task.
- Another US study[47] looked at creative problem solving tasks in three office environments, one with flowers and plants, one with abstract sculpture, and one with no decorative embellishments. In the presence of plants, both women and men generated more ideas and original solutions to problems, with male participants generating 30% more ideas and female participants generating more creative, flexible solutions.

Plants reduce stress and boost mood

In the Planet Ark Valuing Nature Survey, around two-thirds of Australian workers (64%) agree that having regular contact with nature at work would reduce their stress levels, while a similar proportion (65%) agree that it would make them happier (Figure 7). There is considerable research now showing that having plants in indoor workplaces can reduce stress and improve mood among employees:

- A Sydney study[48] found that workers with plants in their offices experienced a 30-60% reduction in feelings of stress, anxiety, depression, fatigue, confusion, and overall negativity during the study period, and just one plant was enough to make the difference. In contrast, participants with no plants experienced a trend towards increased feelings of stress (by 20%).

Around two-thirds of Australian workers agree that having regular contact with nature at work would make them happier.

Australian workers with plants in their offices were found to experience a 30-60% drop in stress, anxiety, depression, anger, fatigue, confusion, and overall negativity, and just one plant was enough to make the difference.

- In the UK, study participants in a heavily planted office undertaking a complex addition task in the presence of distracting noises were found to have lower stress levels during the task, and to recover from their stress more quickly after the test, than those in the unplanted office[49].
- Similar results were found in a US study where participants in a windowless computer room with plants had lower systolic blood pressure readings (indicating lower stress levels) during and after the computer task than those in a similar room with no plants[50].
- Also in the US, workers in offices with plants were found to be more likely than those in plant-free offices to describe their work environment as stimulating or relaxing, and as a pleasant and enjoyable place to be with happy and motivated employees[51].

About two-thirds of Australian workers agree that having regular contact with nature at work would reduce their stress levels, while 65% agree it would make them happier.

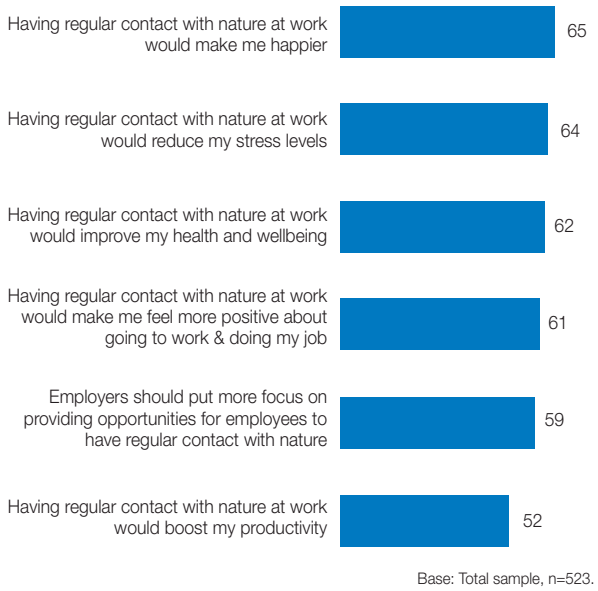


Figure 7. Percentage of Australian workers who agree with the listed statements.

Photo courtesy of Ambius Indoor Plants

The presence of just three potted plants can help employees recover from the mental fatigue associated with screen-based work.

Plants restore attention

A number of studies have shown that interaction with nature can restore attention and help people recover from both visual and mental fatigue:

- In Japan, viewing plants while operating a visual display terminal not only helped study participants recover from visual fatigue but also helped prevent it[52].
- Another Japanese study, this one focusing on mental fatigue, found that worker performance of screen-based tasks in a room with plants was higher than it was for participants undertaking the same task in a plant-free room[53]. The researchers concluded that the presence of plants helped improve the participants' recovery from mental fatigue and that three plants between 15 to 30 centimetres in size were enough to have an effect.

The presence of three 15-30 centimetre pot plants has been shown to improve recovery from mental fatigue after screen-based tasks.

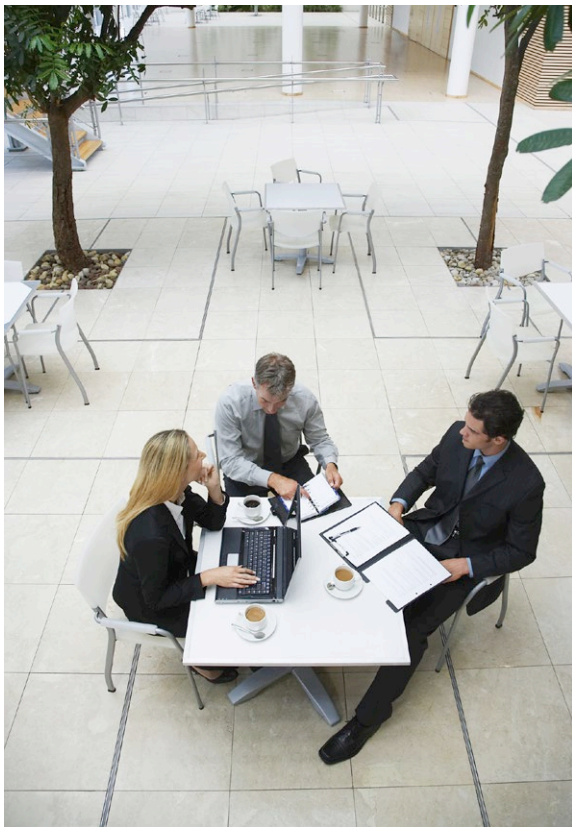
- Mentally fatigued people who walked in a natural environment for 40 minutes were found to perform better on proofreading tasks than those who spent either 40 minutes walking in an urban environment or 40 minutes reading and listening to music in a

quiet room[54]. The researchers concluded that natural environments have a more positive effect on attention restoration.

- People have been found to perform better on a working memory task, that is, they are better able to direct attention, after walking in a park versus walking in an urban area[55].

In a typical week at work, 1 in 4 Australian indoor workers do not take any breaks outside in a natural setting.

Despite the well-documents benefits of taking breaks in natural settings for attention restoration and recovery from fatigue, the Planet Ark Valuing Nature survey found that, in a typical week, 1 in 4 Australian indoor workers do not take any breaks outside in a natural setting. Of the 69% of indoor workers who would like to spend more time outdoors, nearly a third (30%) said they cannot do so because there is no park or natural outdoor area nearby (Figure 2).



Having access to an outdoor break area with natural features at work is as important to Australians as having easy access to shops, banks, and other services.

Plants improve job satisfaction

The Planet Ark Valuing Nature Survey found the 61% of Australian workers agree that having regular contact with nature at work would make them feel more positive about going to work and doing their job (Figure 7). Academic research indicates that the presence of plants in a workplace improves employee perceptions of job satisfaction:

- A large US study found that people who worked in offices with plants or windows overlooking green spaces, reported higher job satisfaction and higher overall quality-of-life than those who did not[56].
- During focus group discussions with UK office workers on the topic of workplaces, job satisfaction, and work performance, all participants associated plants and views of outside green spaces with satisfying aspects of their workplace and with having a positive impact on their job satisfaction[57].

Plants reduce noise

In an indoor environment, plants help control noise by absorbing, diffracting, and reflecting sound. Research has proven that plants can affect the acoustics of a room:

- The results of four trials by UK researchers showed that, particularly at higher frequencies, plants reduce reverberation time and, hence, make a room quieter[58]. The plants achieved better results in 'live' rooms with hard surfaces, such as marble walls, exposed concrete, and stone floors.

The same researchers outlined the best ways to use plants to help control indoor noise levels[59]:

- Use plants that are efficient at absorbing high frequency sounds, for example, Spathiphyllum wallisii (Peace Lily), Philodendron scandens (Sweetheart Plant), Dracaena marginata (Madagascan Dragon Tree), and Ficus benjamina (Weeping Fig);
- Use big, full-bodied, and healthy plants;
- Group three or more plants together and place the grouped plants around the edges and in the corners of the room.

A room with a view: The benefits of views of nature at work

The Planet Ark Valuing Nature Survey found that around two-thirds of Australians (63%) would prefer to work in an environment where they can see natural elements, such as indoor pot plants or a view of trees or a garden (Figure 4). However, the results showed that half of Australian indoor workers cannot see a window that leads directly to the outdoors from their primary workspace, over half (52%) cannot see the sky, and more than a quarter (28%) cannot see any natural outdoor features at all (Figure 3).

Around two-thirds of Australians would prefer to work in an environment where they can see natural elements, such as indoor pot plants or a view of trees or a garden.

Numerous studies have shown that having views of outdoor nature from windows provides many of the same health, wellbeing, and productivity benefits for employees offered by indoor natural features like plants:

- A study comparing three groups of workers, each with a different outside view, found that the employees with views of trees and landscaping took an average of 11 hours less sick leave per year than employees with no view[60]. The quality of a person's view was found to be the primary predictor of absenteeism.
- In the US[61], researchers exposed three groups of participants to one of three conditions: a glass window with a view to nature; a plasma screen with a high-definition view of the same nature setting; or a curtained wall. They then investigated heart rate recovery from low-level stress. The study found that the restorative qualities of the view to nature were significantly higher than both the plasma screen and the curtained wall. The results also show that while, static nature like indoor plants and artwork depicting nature is preferable to no nature at all, it is dynamic nature such as trees swaying or moving water, that reduce stress the most.

Half of Australian workers cannot see a window that leads to the outside and over half (52%) cannot see the sky.

US call centre employees who had views of nature through large windows were found to handle calls 6-12% faster than those with no views, and perform 10-25% better on mental function and memory recall tests.

- Another US study quantified the value of workers having a view to nature[62]. The study found that call centre employees with views of vegetation through large windows from their cubicles handled calls 6-12% faster than those with no views. They also performed 10-25% better on tests of mental function and memory recall, and reported better health and sense of wellbeing. The study found that the costs for the organisation of providing each employee with a window view to nature came to US$1,000 per employee, while the annual productivity savings averaged US$2,990 per employee. The initial

investment payback was achieved within four months, with long-term productivity improvements producing increased profits.

- Computer programmers in offices with windows were found to spend 15% more time on work-related tasks than programmers in interior offices with no windows[63].

A picture says a thousand words: The benefits of simulated nature at work

Findings from the Planet Ark Valuing Nature Survey show that only about 1 in 5 indoor workers (21%) can see artwork (i.e. photos, paintings, or drawings) depicting natural scenes (Figure 3). However, research has shown that virtual nature can be effective in reducing stress and improving mood:

- A Canadian study investigated the effects on stress of immersing an individual into three virtual settings – a virtual nature setting, a virtual urban cityscape, and a neutral environment comprised of solid geometric shapes[64]. Participants who explored the virtual nature environment were found to have significantly lower stress levels and higher levels of happiness, friendliness, affection, and playfulness, compared with those who explored the virtual urban and geometric environments.

Study participants who viewed pictures of nature were better able to direct attention during tasks than those who viewed pictures of urban areas.

- In the US, study participants who viewed pictures of nature were better able to direct attention during two different tasks than those who viewed pictures of urban areas[65].
- Other studies[66,67] have shown that viewing photographs and videos of nature scenes can lead to significant reductions in physiological stress and improvements in emotional states of individuals.

Money well spent: The case for bringing nature into the workplace

While it is difficult to place an absolute economic value on connecting employees with nature during their working day, the studies outlined in this report overwhelmingly confirm that having live plants or simulated nature in the workplace and providing workers with views to outdoor nature have significant benefits for employee health and wellbeing, productivity, and job and employee satisfaction. Results from the Planet Ark Valuing Nature Survey also show that Australians value having access to nature and the outdoors while at work. Nearly 3 in 5 (59%) workers agree that employers should put more emphasis on providing opportunities for employees to have regular contact with nature while at work (Figure 7).

Nearly 3 in 5 Australian workers agree that employers should provide more opportunities for staff to have regular contact with nature at work.

In recent years, workplace health programs, such as stress management workshops, access to gyms, and education programs addressing issues like nutrition have become increasingly common in many workplaces. While these may benefit employees' health and wellbeing, and boost job satisfaction, improving the environment where employees spend many hours of their working day, is likely to have a much greater impact on their ability to maintain and restore attention, manage stress, and perform well at their jobs. In turn, it is likely to have a greater impact on an organisation's outcomes and bottom line.

Positive Action: Invite nature into the workplace

There are a number of simple and low-cost ways that organisations and employees can use nature to boost health and wellbeing, productivity, and satisfaction:

Bring the outdoors in

Place leafy plants around the workplace, including in offices and communal spaces like kitchens, meeting rooms, and break areas. Just one plant is enough to have an impact on stress levels and mood[68] and three plants can help employees recover from mental fatigue[69].

Breathe easy

Improve indoor air quality with three large floor-standing pot plants or six table-sized pot plants for every 10-12 square metres of space[70]. If budget allows, installing a green wall in a workplace can significantly improve air quality.

Changing nature

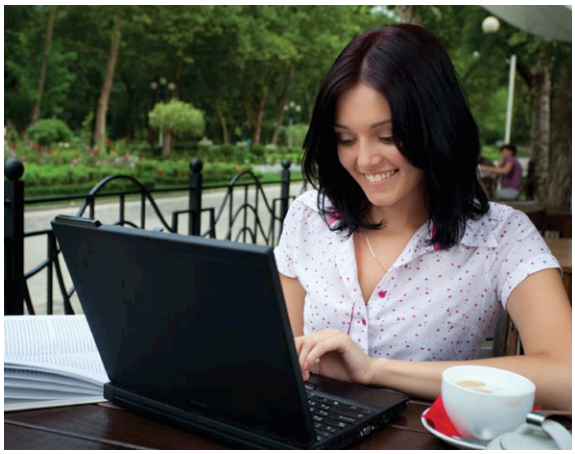
Install a water feature or place plants near open windows – dynamic, or changeable, nature has even greater benefits than static nature.

A room with a view

Arrange workstations and meeting rooms so they allow the greatest amount of natural light from windows into the space and so staff can see outside nature as easily as possible.

Take it outside

Create an attractive courtyard or other outdoor area, complete with plants and flowers, that is accessible to staff for breaks and meals, and even for meetings. Use the area for social events like morning teas and ask volunteers to help establish a vegetable or herb garden, along with worm farm or compost system, and run regular garden maintenance sessions.



Taking a laptop to an outdoor courtyard, park or café to do work is a great way for staff to get into nature during work hours.

Take nature breaks

Develop a culture of outdoor socialising by encouraging employees to eat their meals outside every day, preferably in a courtyard, park, or other natural area, and organise regular outdoor group lunches. Remind staff to take a short break outside when their concentration is flagging. Taking a laptop to a park or outdoor café to do some work is another great way for staff to get a dose of green and stimulate their brain.

Mix business with nature

Host outdoor meetings in a plant-filled courtyard, park, or garden café. Get creativity flowing in meetings and brainstorming sessions by holding "walk and talk" sessions with staff in a park. Organise a lunchtime walk a few times a week or a weekly outdoor exercise session.

Take a virtual break

Hang photos or artwork of natural elements around the workplace and encourage staff to load images of nature as their computer wallpaper. (Free images are available from PlanetArk.org/nature)

Take part in National Tree Day

Planet Ark's National Tree Day is a great opportunity to connect employees with nature and make a positive contribution to the environment. The Workplace Activity Guide has ideas on how to get involved.

VALUING NATURE AT HOME

Trees and other natural elements in the home and neighbourhood provide a wide range of economic, environmental, health, and social benefits. They can:

- increase property values;
- reduce home and business costs;
- boost business profits;
- tackle environmental issues, such as the urban heat island effect, climate change, air pollution, and flooding;
- improve biodiversity;
- improve residents' health;
- help make communities safer and more pleasant places to live.

It is common knowledge that the "leafy" suburbs in a city – those with an abundance of trees, parks, and gardens – are generally the most desirable, and most expensive, areas in which to live. One of the aims of the Planet Ark Valuing Nature Survey was to investigate Australians' views on living in a nature-filled home and neighbourhood, and how important it is to Australians to have nature on their doorstep.

Give me a home among the gum trees

The results of Planet Ark's Valuing Nature Survey show that people value having access to nature at home and in their neighbourhoods. Around four out of five Australians (78%) said they would prefer to live in a home with many natural elements, such as trees, plants, and a garden, over one that does not have these features (Figure 8). Australians are also prepared to dig deeper to live in a nature-filled neighbourhood. Assuming a base house cost of $500,000, Australians would be willing to pay an average of $35,000 more (about 7% of base cost) for a home in a green neighbourhood than for the same kind of home in an area with little surrounding nature. Around one third of Australians (34%) would pay an extra $100,000 (20% of base cost), while 15% of people would pay an extra $120,000 or more (Figure 9).

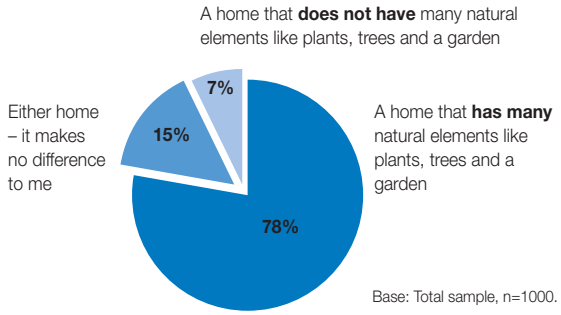


Figure 8. Percentages of total sample who chose the different types of homes listed as their preferred home.

Australians would be willing to pay an average of $35,000* more to buy a home in a "green" neighbourhood. More than 1 in 3 people would be willing to pay an extra $100,000*.

***Assuming a base house cost of $500,000.**

When asked to consider their ideal home and rank the importance of 14 different home features to them, Australians rated having a home with a backyard and living in a "green" neighbourhood with many trees, parks, and gardens even higher than (Figure 10):

- being close to work;
- having easy access to public transport; and
- having good shops or a shopping centre nearby.

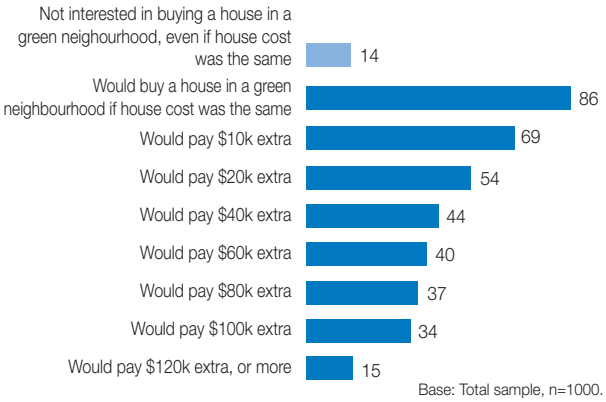


Figure 9. Percentage of total sample who would pay the extra amounts listed* to buy a home in a neighbourhood with lots of trees, parks, and gardens, compared with an identical house in an area with little nature.
***Assuming a base house cost of $500,000.**

A backyard is considered by Australians to be the most important feature of their ideal home.

Australians consider having a home with a backyard and living in a nature-filled neighbourhood to be even more important than living close to work, having easy access to public transport, and having good shops nearby.

Compared to the general population, the preference for a "green" home is higher among women, people with children, Australians who are concerned about the environment, and people in the later stages of their life, specifically those with older children and "empty nesters".

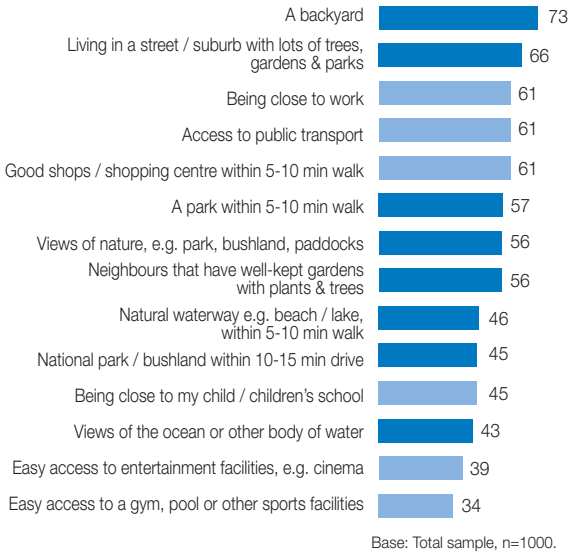


Figure 10. Percentage of total sample who consider the listed features to be important qualities of their ideal home.

What is a tree worth?

Over the past decade, many cities in the US have used economic modelling to quantify the economic benefits of urban trees. Online modelling tools, such as i-Tree, allow communities to quantify environmental and other benefits, and justify investments in urban greening projects. For example, a 2007 study found that New York City's street trees return US$5.60 to the community for every US$1 spent on management[71]. The annual net benefit the trees provide to residents is about US$122 million. Over half the annual benefits (57%) are environmental services, such as stormwater runoff reduction, energy savings, air quality improvement, and CO2 reductions, while 43% is comprised of annual increases in property value.

A typical Adelaide street tree generates an estimated $424 per year in gross environmental and property benefits.

In recent years, similar studies have been done to value trees in a number of Australian cities:

- In Adelaide, researchers estimated that a typical street tree generates gross annual benefits of A$424, made up of energy savings from reduced air conditioning use, air quality improvements, storm water management, aesthetics, capital appreciation, carbon sequestration, and other benefits[72].
- In Canberra, the city's trees have been estimated to have an annual economic value of more than A$23 million through energy reduction, pollution mitigation, and storm water reductions[73].
- In Melbourne, researchers compared the economic benefits of street trees in the City of Melbourne and the City of Hume[74]. For the environmental benefits of carbon sequestration, water retention, energy saving, aesthetics, and air pollution removal, the trees in two City of Melbourne suburbs were found to provide ecosystem services worth about A$1 million, while in the City of Hume, trees were found to provide services of A$1.5 million. At an individual level, each tree in the two City of Melbourne suburbs provides ecosystem services to the value of A$163, while each tree in Hume provides A$89 worth of services.

Brisbane's half a million street trees provide an estimated annual benefit of $1.65 million for air pollutant removal, carbon sequestration, and rainfall interception.

- Brisbane's more than half a million street trees provide an estimated annual benefit of A$1.65 million for air pollutant removal, carbon sequestration, and rainfall interception[75].

The primary costs associated with planting and maintaining trees or other vegetation include purchasing materials, initial planting, and ongoing maintenance activities such as pruning, pest and disease control, and irrigation. While the benefits of urban forests can vary considerably between communities and tree species, they almost always outweigh the costs.

Broad-leaved trees in suburban streets of northern Perth have been found to increase the median property value in the street by $16,889.

- Utilising data from 23 northern Perth suburbs, researchers from Western Australia found that broad-leaved trees on suburban street verges increase the median property value in the street by A$16,889[76].
- According to a Real Estate Institute of Queensland survey, the value of Brisbane homes in "leafy" streets was up to 30% higher than those in streets with few trees[77].
- Looking at more than 2600 real estate transactions in Portland, Oregon, researchers found that homes with street trees sold for an average of US$8,870 more, and 1.7 days more quickly, than homes without street trees[78]. The effect stretched to neighbouring homes within 30 metres of street trees, which sold for an average of US$1,688 more. It was estimated that street trees could contribute an additional US$15.3 million in property tax revenue to the city.

Money does grow on trees: The economic benefits of a natural home and neighbourhood

Trees and other vegetation can increase the value of most people's biggest asset – their home. They can also boost the profits of local business, and save homeowners, businesses, and governments money.

Nature lifts property prices and increases tax revenues

The finding from the Valuing Nature Survey that Australians would be happy to pay more (an average of $35,000 more on a $500,000 house) to buy a home in a "leafy" neighbourhood (Figure 9) mirrors the findings of a number of national and international studies:

Australians are willing to pay on average $35,000* more for a home in a neighbourhood with lots of trees, parks, and gardens. *Assuming a base house cost of $500,000.

- Being located within around 150 metres of a park in Washington, D.C., increased the value of property by approximately 5%[79]. This equated to a total value increase for all properties near parks of US$1.2 billion in 2006, which in turn added almost US$7 million in property tax returns to the city.
- A study in British Columbia, Canada, found that having access to a suburban riparian greenway (i.e. a protected corridor along a waterway) was second only to affordability in the factors people considered when choosing to live in one of the study areas[80]. Access to a greenway was found to increase property values by 10-15%.

Nature boosts business

Research has shown that nature can boost the viability of businesses by drawing shoppers into business districts and encouraging them to spend more:

US shoppers have been found to pay 9-12% more for goods sold in business districts with high quality tree canopy.

- Not surprisingly, US research found that customers prefer shopping in well-tended streets with large trees[81]. The study also found they would pay 9-12% more for goods sold in central business districts with high quality tree canopy, and would travel further to, visit more often, pay more for parking, and stay longer in a shopping district with plenty of trees.
- Daylight has also been shown to boost retail sales in shopping centres. Researchers studied a chain of 73 retail stores throughout California – 24 stores had significant daylight illumination, while the remaining 49 relied on artificial light[82]. The study found that after installing skylights, stores enjoyed a 40% increase in gross sales, along with a reduction in energy costs. It was estimated that installing skylights in retail buildings across California would increase sales by US$47.5 million and reduce energy costs by US$2.5 million.

Trees and landscaping also impact positively on office rental rates. A study of 85 office buildings comprising 270 individual leases in Cleveland, Ohio, found that aesthetically pleasing landscaping added about 7% to the average rental rate of a building[83].

Shoppers have been found to stay longer and spend 9-12% more for goods in shopping districts with high quality tree canopy.

Trees, parks, and gardens can contribute to local economies in a variety of other ways, for example, by providing free recreation services to residents and visitors, encouraging recreational tourism, and providing green industry jobs like park rangers, tourist guides, landscapers, and planners[84].

Nature reduces energy and water costs

Since 1910, climate change has seen Australia's annual average temperature increase by 0.9°C[85]. As temperatures increase, so too is our use of air conditioners. For every 1°C increase in temperature, air conditioning use increases by about 5%[86]. Between 1994 and 2004, ownership of air conditioning units in Australia almost doubled.

In a hot, dry climate, the cooling effect from transpiration of a large tree has been estimated to be the same as running five air conditioners for 20 hours.

Trees and plants act as natural air conditioners. In summer, trees cool and reduce the energy use of a building in two ways: firstly, by providing direct shade to windows, walls, roofs, and the soil surrounding a building (which acts as a heat sink); and secondly, by transpiration, the process by which plants release moisture in the form of water vapour[87]. In a hot, dry

climate, the cooling effect from transpiration of a large tree has been estimated to be equivalent to that of running five air conditioners for 20 hours[88]. A tree shading an outdoor air conditioner can also increase its efficiency, thereby lowering its running costs. In winter, the presence of trees can help reduce the cooling effect of cold winds[89]. The actual benefits received from trees are influenced by the climatic conditions, the type of tree shade, and the properties of the building they shade.

In recent years, an increasing number of studies have measured and modeled the climate and energy benefits of urban trees:

- It has been estimated that each shade tree over a house in an Australian city could save ~30 kilowatt-hours (kWh) per year in energy used for air conditioning[90]. Based on this figure, 100,000 mature shade trees in an Australian city could save approximately half a million Australian dollars in energy costs[91].

A home in Auburn, Alabama, with 50% dense shade coverage during the day was found to use nearly 20% less energy than a home with no shade, saving around US$42 a month.

- A study in Auburn, Alabama, estimated that a house with 50% dense shade coverage during the day uses nearly 20% less energy than a home with no shade, saving around US$42 per month[92].
- In Sacramento, California, having trees on the west and south sides of a house was found to reduce summertime electricity use by 5.2%[93]. Furthermore, having a London plane tree planted on the west side of a house was estimated to reduce carbon emissions from summertime electricity use by an average of 31% over 100 years.

By casting their shade over buildings, trees and shrubs help reduce energy use, as well as demand for water required by cooling towers, air conditioners, and even for personal cooling like showers. In the garden, planting hardy, drought-tolerant native species can also reduce water use. Many trees, once established, may not require additional watering as the roots will absorb water from the groundwater table. Trees also shade a garden, helping other plants stay cool, further reducing household water use.

Nature lowers food costs and improves food security

With the increasing loss of agricultural land on urban fringes to development, and rising concerns about peak oil and the impact of climate change and extreme weather events on food prices, local councils, businesses, and individuals are becoming more and more concerned with integrating food production into urban areas.

One of the motivations for people to grow their own food is to reduce food costs. A recent Australian survey[94] found that more than half of Australian households (52%) are growing some of their own food, mostly in home gardens, with a further 13% intending to start. Of those growing their own food, 62% said they did so to save money.

If the lawn space of an average suburban garden was converted to food production, it could provide enough produce to meet a typical household's annual fruit and vegetable needs.

More than half of Australian households are growing some of their own food, with a further 13% intending to start. One of the main reasons people grow food at home is to save money.

A number of studies have estimated the value to a household of growing food at home:

- It has been estimated that if the lawn space of the average Australian suburban garden was converted to food production (leaving a 20 metre square open space area), it could produce between 800 and 1100 kilograms of fresh produce a year, enough to provide a typical household with a year's supply of vegetables and some fruit[95].
- In the US, a study estimated that a 97 square metre home garden could produce almost all the vegetables required for two people for a year[96].

While installing and managing a large food garden may be unrealistic for many people, even the produce from a small plot or a few pots could save gardeners money by supplementing one or two meals a week, and supplying produce that is expensive to buy commercially, such as berries and "greens" like spinach and herbs.

In addition to saving money, food gardens can also reduce food waste, because gardeners can pick small amounts of produce as they need it, rather than having to buy large quantities from the supermarket or store. Gardens can also provide the opportunity for people to compost any food waste they do produce.

A green planet is a healthy planet: The environmental benefits of nature

Trees and other vegetation in urban areas – sometimes referred to as "green infrastructure" – provide an extensive range of ecological services. They reduce the urban heat island effect, clean air and water, improve soil health, reduce stormwater runoff and flooding, help communities mitigate and adapt to climate change, and increase biodiversity. In this era of worsening climate change, the roles of reducing the urban heat island effect and helping communities tackle and adapt to climate change are particularly important.

Nature cools hot cities

The summer of 2012 / 13 saw Australia experience its worst heatwave on record[97]. As climate change continues, Australia is likely to experience more frequent, more intense and longer-lasting heatwaves[98].

Due to the urban heat island effect, temperatures in a city's central business district can be 1–3°C warmer than surrounding areas and up to 12°C warmer at night.

Since 1890, heatwaves have caused 2887 deaths in Australia – more deaths than bushfires, floods, earthquakes, cyclones, and severe storms combined[99]. Heatwave-related deaths in Australian cities are predicted to more than double in the next 40 years as a result of climate change, population growth, and an ageing population[100]. Groups most at risk of adverse health effects from heatwaves include the elderly, the socially disadvantaged, people with underlying physical and mental health conditions, and those living alone[101].

Major heatwaves are a particularly deadly hazard for cities because of the urban heat island effect – the phenomenon where the air and surface temperatures of cities are significantly higher than the surrounding vegetated and rural areas, particularly at night[102]. During the day, heat-absorbing materials that dominate cities, including concrete buildings and pavements, bitumen roads, and dark-coloured roofs, store heat energy, which is then slowly released during the night. Other factors contributing to the urban heat island effect include the burning of fuel for transportation and heating, urban canyons that trap hot air, and a lack of green space and vegetation.

During the 2009 summer heatwave, the Melbourne CBD experienced night-time temperatures up to 5°C higher than non-CBD areas. Increasing urban green cover is one of the best ways to reduce the urban heat island effect.

The annual mean air temperature of a city with 1 million people or more can be 1–3°C warmer than its surrounding areas[103]. In the evening, the difference can be as high as 12°C[104]. During the major heatwave in the summer of 2009, Melbourne CBD areas experienced night-time temperatures up to 5°C higher than non-CBD areas[105]. In cities, the urban heat island effect robs people of the ability to recover overnight from high daytime temperatures, which can result in increased heat-related illnesses and deaths. During the 2009 heatwave, there were 374 more deaths in Victoria between 26 January and 1 February than there had been in the same period of 2008 – a 62% increase[106]. Most of those who died lived in Melbourne and were aged 65 years and older.

One of the best ways to reduce the urban heat island effect is by increasing the amount of vegetation in a city. Public parks, remnant woodlands, residential gardens, nature strips, street trees, green roofs, green walls, and rain gardens all play a part in keeping the temperatures of a city down and improving its liveability. Thermal mapping in Melbourne shows that, on average, a 10% increase in urban green cover could reduce the daytime surface temperature in cities during heatwaves by around 1°C[107]. Thermal imaging of a plane tree on a day when the air temperature was 32.4°C showed the surface temperature below the tree to be 42°C lower than surrounding hard surfaces with no shade cover[108]. In Shanghai, China, increasing the urban green area from 19% to about 35% played a significant role in reducing the number of heatwave deaths in the city[109].

The temperature under a plane tree in Melbourne on a 32°C day was shown to be 42°C lower than the surrounding hard surfaces with no shade cover.

Not only does urban vegetation help reduce the risk of death and illness from heatwaves, it also helps reduce energy use, CO2 emissions, air pollution, demand for water, and anti-social behaviour.

Nature helps tackle climate change

Green infrastructure, particularly trees, plays a critical role in helping communities mitigate, as well as adapt to, climate change.

Increasing concentrations of CO2 in the atmosphere is the main cause of climate change[110]. One of the ways trees reduce the level of CO2 in the atmosphere is by capturing and storing carbon, also known as carbon sequestration. On average, trees absorb 1 tonne of CO2 for every cubic metre of growth, producing 727 kilograms of oxygen[111].

While mature forests with continuous canopies store the most carbon, urban trees, though smaller and generally more short-lived, also play an important role. For example, it has been estimated that 100,000 public trees in Melbourne sequester about 1 million tonnes of carbon[112]. In 2000, a Brisbane study estimated that the city's residential tree cover absorbed the equivalent amount of CO2 emitted by 30,000 cars per year[113].

The 30,500 urban trees along a 19 km stretch of the Pacific Highway in Sydney have been estimated to store around $1.65 million of carbon.

In recent years, a growing number of studies using the i-Tree modeling tool have investigated and placed a value on the ability of urban forests to store carbon and avoid carbon emissions:

- The 30,500 urban trees located along a 19 kilometre stretch of the Pacific Highway in northern Sydney have been shown to deliver a combined annual benefit of A$97,770 from carbon sequestration, air pollution removal, building energy savings, and avoided carbon emissions, while storing an estimated A$1.65 million of carbon (at A$23 per tonne[114].

Trees and other vegetation in urban areas can help communities mitigate and adapt to climate change.

- New York's urban forest removes an estimated 42,300 tonnes of carbon from the atmosphere each year (valued at US$779,000 per year) and stores about 1.35 million tonnes of carbon, worth around US$24.9 million[115].
- Chicago's 157 million trees remove an estimated 677,000 tons of carbon from the atmosphere each year, worth around US$14.0 million per annum, while storing about 16.9 million tonnes of carbon valued at US$349 million[116].

Trees and other vegetation also help communities adapt to climate change. In addition to higher temperatures across the country, and reduced rainfall and extended periods of drought across southern Australia, climate change is also likely to lead to increased bushfire risk and more extreme weather events like severe storms[117]. Not only can trees and other vegetation help cool towns and cities, they can also reduce runoff and flooding during severe storms, lower wind speeds, and provide protection during certain weather events, such as hail storms[118].

A green revolution

Green roofs and green walls are now a common sight in many cities around the world and have become a growth industry. Just like trees and other green infrastructure, green roofs and walls provide a range of ecosystem services in urban areas, including improving air quality, cooling buildings, mitigating the urban heat island effect and stormwater run off, and improving the amenity of cities.

Green roofs and walls also:

- Insulate a building from the weather and noise;
- Improve the efficiency of solar panels by maintaining the surrounding temperature at an optimum level;
- Increase the lifespan of a roof by limiting exposure to the sun and elements;
- Utilise previously unused space for recreation, gardening, and food growing.

Green roofs and walls have been shown to have many potential benefits:

- It has been estimated that if all available roofs in Chicago had green roofs installed, they would remove 2046 metric tonnes of pollutants[119].
- If the same was done in Toronto, the city would reap initial savings of CAD$313 million and an annual cost saving of CAD$37 million (in 2004 dollars)[120].
- In Singapore, research found that a green wall provided a temperature difference of 3.6°C between the external and internal building environments[121].

The City of Sydney has adopted Australia's first green roofs and walls policy. The city has more than 80 green roofs and walls, with another 70 in the pipeline[122]. In the CBD, No. 1 Bligh Street features a green wall covering 377 square metres, while in Surry Hills, Prince Alfred Park Pool has the largest green roof in the city, with over 35,000 plants. Sydney also has the tallest vertical garden in Australia. Covering 1200 square metres, the garden at One Central Park, Chippendale, features 2700 planter boxes, and the greenery will eventually cover 50% per cent of the building's façade. Green roofs and walls are on the rise in a number of other Australian cities, including Melbourne, Brisbane, Adelaide, and Perth.

Choosing the right plants is critical for making a green roof or wall work, with factors like available sun and shade, requirements for water and light, soil depth, and plant durability and longevity all important considerations.

Green roofs and walls and provide a range of ecosystem services, including improving air quality, cooling buildings, and reducing and cleaning stormwater runoff.

Our sedentary and largely indoor lifestyles are contributing to a range of health issues, including rising rates of obesity, heart disease, diabetes, and mental illness.

Glowing green: The health benefits of a natural home and neighbourhood

Not only have our working lives moved indoors, our leisure time is now also largely spent inside. Research commissioned by Planet Ark in 2013 found that, on average, Australians spend just 4.7 hours per week doing outdoor recreational activity[123]. In contrast, we spend over 32 hours of our leisure time each week watching television or on the internet[124]. Our sedentary and largely indoor lifestyles are contributing to soaring rates of obesity, heart disease, diabetes, mental illness, and a range of other health issues. Nature, in the form of trees, plants, parks, gardens, wilderness, and even agricultural land, has the power to help redress many of these issues.

More than two-thirds of Australians agree that living in a "green" neighbourhood would reduce their stress levels.

Many Australians appear to value the health and wellbeing benefits of living in a home and neighbourhood with lots of nature. According to the Planet Ark Valuing Nature Survey, more than two-thirds of Australians (68%) agree that living in a neighbourhood with lots of trees, gardens, and parks would reduce their stress levels, and 2 out of 3 Australians (66%) agree they would be more likely to do outdoor exercise if they lived in a green neighbourhood (Figure 11). Australians identify having a backyard and living in a neighbourhood with lots of trees, gardens, and parks as even more important than having easy access to work, shops, and public transport (Figure 10). Nearly 3 in 5 Australians (57%) say that having a park within 5-10 minutes walk of their home is important to them, while a similar proportion (56%) report that having views of nature, such as a park, bushland, or paddocks, is important (Figure 10).

Two-thirds of Australians agree they would be more likely to do outdoor exercise if they lived in a nature-filled neighbourhood.

Access to nature has been linked to better health and lower mortality. A Dutch study of 17,000 people found that those living within 3 kilometres of nature or green spaces reported fewer medical symptoms, as well as better perceived general health and mental health, than those living in densely urbanised areas with little or no access to green space[125]. Assuming that green space actually causes better health, the study indicates that a 10% increase in green space in a neighbourhood could lead to a decrease in the number of symptoms that is on par with a decrease in age by five years.

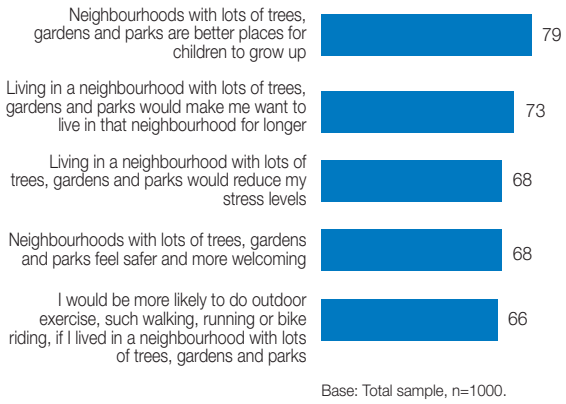


Figure 11. Percentage of total sample who agree with the listed statements.

In 2012, Planet Ark produced the report, *Planting Trees – Just What The Doctor Ordered?*[126], which detailed the intellectual, psychological, physical, and mental health benefits for children of regular contact with nature. These include:

- Reducing stress and depression;
- Reducing the risk of being overweight or obese;
- Reducing symptoms of ADHD;
- Increasing self-esteem and confidence;
- Improving creativity and imagination.

While more and more people are becoming aware of the benefits of contact with nature for kids, the benefits for adults are less well known.

Nature helps clear the air at home

Given the amount of leisure time we now spend indoors, the quality of air in our homes is an important health and wellbeing issue. Sources of indoor air pollutants in typical homes include: fabric and furnishings; paints; surface finishes like stains, varnishes and wood coatings; sealants and adhesives; carpets; construction materials; appliances, such as computer equipment, televisions, air conditioners, and unflued heaters and cookers; personal care products; and pesticides[127].

Photo courtesy of Smack Bang Designs.

Plant-filled rooms have been shown to have 50-60% less airborne microbes than similar rooms without plants.

Poor indoor air quality can lead to a range of health issues, including irritation of the eyes, nose, and throat, headaches, dizziness, fatigue, and respiratory issues like asthma[128]. Other more serious health issues may show up years after exposure or only after long or repeated exposures, including some respiratory diseases, heart disease, and cancer[129]. The people who happen to spend the most time indoors are also the people most at risk of developing health issues as a result of indoor air pollution[130], namely young children, the elderly, and the chronically ill, especially those suffering from respiratory or cardiovascular disease.

Plant-filled rooms have been found to have 50-60% less airborne microbes than rooms with no plants, as long as the soil is covered with a porous material.

As outlined earlier in this report (see Valuing Nature at Work), potted plants can significantly reduce the indoor concentrations of toxic air pollutants, such as VOCs and particulate matter, and reduce the symptoms and health risks associated with air pollution. Plants can also help rid a home of illness-causing microbes. A US study found that plant-filled rooms have 50-60% less airborne microbes than similar rooms without plants, provided the soil is covered with a layer of gravel or other porous material[131]. The study found the plants transpired mineral-free moisture that appears to contain substances that inhibit the growth of airborne microbes, while increasing the humidity in a room. Plants in a home may help to reduce health issues triggered by dry air, such as asthma and nasal congestion, and lower the incidence of colds, particularly during winter when the air is naturally drier.

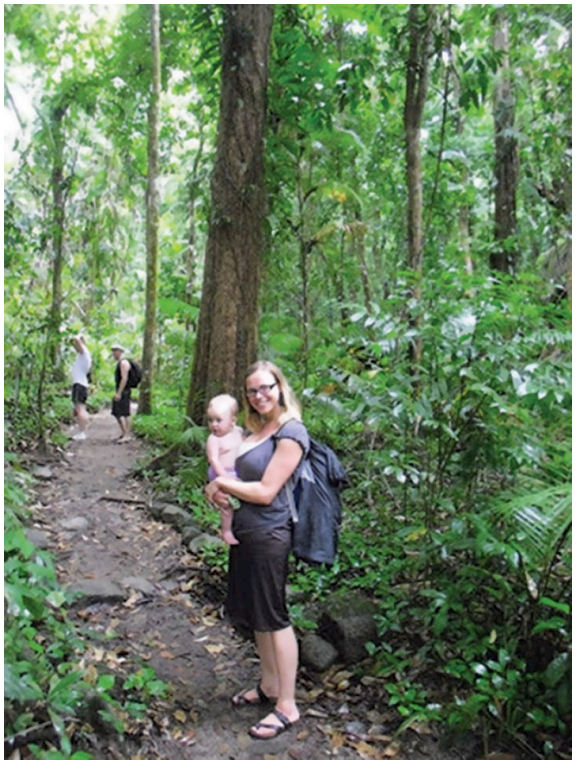
Nature lowers stress and improves wellbeing

Stress is a growing issue in Australian society. In 2013, the Australian Psychological Society found that Australians had significantly lower levels of stress and distress, as well as higher levels of depressive and anxiety symptoms, and significantly lower levels of wellbeing, than in the previous two years[132]. Half of Australians surveyed identified finances as a source of stress, with women also identifying family issues as a

leading source of stress. Chronic stress can lead to a range of serious health issues, including heart disease, high blood pressure, diabetes, depression, and anxiety disorder[133].

Compared with walking in urban areas, walking in forests has been found to result in around 13-15% lower levels of the stress hormone salivary cortisol, a 4-6% lower pulse rate, and reduced blood pressure.

Australians on the whole understand the benefits of living in a neighbourhood with lots of trees, gardens, and parks. The results of the Planet Ark Valuing Nature Survey show that more than two-thirds of respondents (68%) agree that living in a green neighbourhood would reduce their stress levels (Figure 11). Many academic studies clearly demonstrate the power of nature for reducing stress:



Walking through forests has been shown to significantly reduce people's stress levels.

- A study of "Shinrin-yoku", the ancient Japanese practice of restorative walks through natural settings, mostly forests, found that, compared to people walking though built-up urban areas, those who walked through a forest had, on average, around 13-16% lower levels of salivary cortisol (a stress hormone), a 4-6% lower pulse rate, and lower systolic and diastolic blood pressure. Most significantly, in subjects who walked through a forest, overall parasympathetic activity— which occurs when we feel relaxed— increased by about 56%, whereas sympathetic activity—which occurs when we feel stressed—decreased by just over 19%[134].
- A Swedish survey[135] found that people who visited green spaces more often had lower levels of stress. Unsurprisingly, distance to green spaces determined the frequency of visits, with people living closer to green spaces visiting them more often.
- The restorative benefits of contact with nature can be felt after just two visits to an urban forest or a park, as shown by a Swiss study[136]. Participants experienced an average stress recovery rate of 87% and an average reduction in headaches of 52%. The study concluded that attractive design of parks is important, as there appears to be a link between aesthetics and environmental preference, as well as aesthetics and expected and experienced restoration.
- Nature has a positive effect even when it is not real, with research showing that slides of urban scenes with vegetation create a positive effect on people's cognitive and emotional experiences of the urban setting, and their expectations of quality of life in the area[137].

Nature improves mental health

According to a 2009 Australian Bureau of Statistics survey[138], one in five (20%) Australians aged 16–85 years experienced one of the more common mental illnesses in the previous 12 months. The annual cost of mental illness in Australia has been estimated at A$20 billion, which includes the cost of loss of productivity and labour force participation[139].

Nature has the power to help lower the effects of poor mental health:

Adelaide residents who perceived their neighbourhoods to be very green were 1.37 to 1.6 times more likely to report better physical and mental health.

- Research found that Adelaide residents[140] who perceived their neighbourhoods to be very green were 1.37 to 1.60 times more likely to report better physical and mental health respectively than those who perceived their neighbourhoods to be lower in "greenness". Perceived greenness was also correlated with recreational walking and social factors, which in turn were associated with mental health.
- A study of data from 195 general practitioners investigated the relationship between green space close to people's homes and their morbidity (rate of incidence of a disease) for 24 selected diseases[150]. People who lived within 1 kilometre of green space were less likely than those who lived further away to have 15 of the 24 diseases, with the relationship being strongest for anxiety disorder and depression. It was also strong for children and people with lower socio-economic statuses, who tend to spend more time closer to home. The researchers concluded that green spaces closer to home appear to play a major role in disease prevention.
- Residents who had plants installed in their apartment in Seoul, Korea, were found to display less psychosomatic symptoms, hostility, anxiety, obsessive-compulsive disorder, and depression than those living in apartments without plants[151].

Nature is linked to more exercise and lower obesity

Regular physical activity has significant health benefits[152]. It can:

- Reduce the risk of, or help manage, type 2 diabetes;
- Reduce the risk of, or help manage, cardiovascular disease (CVD);
- Maintain and / or improve blood pressure, cholesterol and blood sugar levels;
- Reduce the risk of, and assist with rehabilitation from some cancers;
- Prevent unhealthy weight gain and assist with weight loss;

Two out of three Australians agree they would be more likely to do outdoor exercise if they lived in a green neighbourhood.

- Build strong muscles and bones;
- Create opportunities for socialising and meeting new people;
- Help prevent and manage mental health problems;
- Help develop and maintain overall physical and mental wellbeing.

The Australian Government Department of Health recently doubled the recommended amount of physical activity adults should get each week[153]. The new guidelines recommend that adults aged 18-65 years do 150 to 300 minutes (2 ½ to 5 hours) of moderate intensity physical activity or 75 to 150 minutes (1 ¼ to 2 ½ hours) of vigorous intensity physical activity, or an equivalent combination of both[154]. It also recommends that adults be active on most, preferably all, days of the week, and that they minimise the amount of time they spend sitting for long periods.

Worryingly, the Australian Bureau of Statistics found that in 2007 / 08, 6 out of 10 Australians did not meet the Department's previous recommended levels of activity, that is, 30 minutes of moderate exercise on most days of the week[155]. It is likely that an even greater proportion of Australians would not meet the new recommended levels. Australian research showed that, in 2010, the median annual health care cost for inactive middle-aged women was A$741 per year, versus A$689 per year for active women, a difference of A$52[156]. Extrapolated to a

national level, the study estimated that a lack of exercise is costing the Australian healthcare system A$40 million a year for women alone.

The Planet Ark Valuing Nature Survey shows that two-thirds of Australians (66%) agree they would be more likely to do outdoor exercise, such as walking, running, and cycling, if they lived in a neighbourhood with lots of trees, gardens, and parks (Figure 11). Nearly 3 out of 5 Australians (57%) say that having a park within 5-10 minutes walk of their home is important to them (Figure 10).

Perth residents who had good access to large, attractive public open space with many natural elements were found to be 50% more likely to undertake high levels of walking than those with poor access.

A number of studies show links between access to green space, such as urban parks, and increased physical activity, as well as lower levels of reduced obesity:

- Perth residents who had very good access to large, attractive public open space, such as a park with trees, water, and birdlife, were found to be 50% more likely to undertake high levels of walking than those with poor access[157].
- The amount of green space in Australian residential areas has been shown to influence whether people undertake moderate to vigorous physical activity. People aged over 45 years who lived in areas with high levels of green coverage were found to be significantly more likely to both walk and undertake moderate to vigorous physical activity than those living in areas with less than 20% green coverage[158].

Residents of eight European cities were found to be three times more likely to be physically active, and about 40% less likely to be overweight and obese, if they lived in green areas.

- Residents of eight European countries were found to be three times more likely to be physically active, and about 40% less likely to be overweight and obese, if they lived in areas with high levels of greenery.[159].

Surgery patients who can see nature from their hospital bed have been shown to recover faster, have less stress, and require less pain medication than those who look at brick walls.

Nature promotes healing

According to the National Health Performance Authority[160], in 2011 / 12, there were more than 5.7 million stays in public hospitals across Australia. Of these, 2.9 million stays lasted one or more nights, accounting for 16.3 million bed days. The length of hospital stays varies considerably depending on the health issue being treated. For example, in 2011 / 12, patients being treated for heart failure without complications stayed an average of 5.1 days in public hospitals, while those who had their gallbladder removed spent on average 1.9 days in hospital[161].

Reducing the length of hospital stays, without compromising quality of care and patient outcomes, frees up beds for the treatment of other patients and reduces the cost per patient. A shorter hospital stay is also beneficial for the patient, enabling them to return home and recommence their normal life activities more quickly.

A hospital was able to release surgery patients who had views of nature 0.74 days earlier than those who had views of brick walls.

Research has shown that nature can help people heal after surgery and reduce the length of hospital stays:

- Being able to see greenery from bed while recovering from gallbladder surgery resulted in patients who recovered faster, had less stress, received fewer negative evaluative comments in nurses' notes, and took fewer potent pain-killers, than those who had

a view of a brick wall[162]. On average, the patients who looked at brick walls stayed for 8.70 days, while patients whose windows overlooked a natural scene were released after 7.96 days, a difference of 0.74 days or 8.5%. When the average per day cost of a hospital stay after surgery in the US ($5,059 in 2004) is applied to the 46 patients in this study, it is found that the cost of patient care could have been reduced by about US$161,000 if the patients had been able to be released just one day sooner[163].

- Patients who were able to look at pictures of nature had reduced levels of post-operative anxiety than those who looked at abstract pictures[164].

Gardening grows a healthier life

According to the Planet Ark Valuing Nature Survey, out of 14 different natural and non-natural features, a backyard is the one considered by Australians to be the most important. Three-quarters of Australians (73%) report that a backyard is an important feature of their ideal home (Figure 10). Having a backyard and living in a street or suburb with lots of trees, gardens, and parks are the most important home features to Australians, even more important than having easy access to work, shops, and public transport (Figure 10). Nearly 3 out of 5 Australians (56%) value having neighbours with well-kept gardens featuring trees and plants (Figure 10).

In an Australian survey, 86% of Australians said the main reason they spend time in their backyards is because of the health, wellbeing, and relaxation benefits their garden provides.

In a Nursery and Garden Industry Association survey, 86% of Australians reported that the health, wellbeing, and relaxation benefits their garden provides is the main reason they spend time in their backyards[165]. Having a garden at home, and participating in gardening, either at home, in the community, or as part of a therapy program, have been shown to have a wide range of health benefits, including a reduction in stress, anxiety, and depression, improved cardiovascular health, and reduced risk of stroke:

- Having a garden of one's own, or immediately adjacent to one's home, has been found to have a significantly positive impact on stress, as does visiting the garden frequently. The more lush the garden greenery, the more positive the impact[166].
- Domestic activity, such as gardening, was found in a Scottish study to be associated with a 13–20% reduction in the risk of psychological distress[167], while in Australia, a study found that physical activity, such as gardening, may cause a reduction in anxiety and depression in the elderly[168].
- A review of evidence regarding physical activity and cardiovascular disease (CVD) shows that light to moderate physical activity, such as gardening or walking, in middle or older age significantly reduces the risk of coronary heart disease (CHD) and cardiovascular mortality in both men and women[169]. It suggests that physical activity is also associated with reduced risk of stroke.

Gardening has been shown to reduce stress, anxiety and depression, as well as a number of physical health issues, including cardiovascular disease.

Gardening has also been shown to be beneficial for people with a range of diseases and health issues, including diabetes, dementia, Alzheimer's, brain injury, and mental illnesses like schizophrenia and post-traumatic stress disorder[170].

Growing a stronger community: The social benefits of nature

Nature influences our perception of a neighbourhood, as well as our behaviour. It can: help build a sense of identity; foster strong social bonds within a community; and help people feel safe, supported, and more positive about where they live. A person's social ties are linked to health outcomes – people with strong social relationships tend to live longer[171] and be physically and mentally healthier[172].

More than two-thirds of Australians agree that neighbourhoods with lots of trees, gardens, and parks feel safer and more welcoming than those with little nature.

Australians, particularly women and older people, understand the community benefits of a nature-filled neighbourhood. In the Planet Ark Valuing Nature Survey, more than two-thirds of Australians (68%) agree that neighbourhoods with lots of trees, gardens, and parks feel safer and more welcoming than those without nature (Figure 11). Around 4 out of 5 Australians (78%) agree that nature-filled neighbourhoods are better places for children to grow up (Figure 11).

More than two-thirds of Australians agree that neighbourhoods with lots of trees, gardens and parks feel safer and more welcoming than those with little nature.

Being actively involved in community environmental groups can build people's sense of belonging in their community and help them feel more supported, which in turn reduces their stress levels.

Nature connects neighbours

Having social relations with neighbours is one of the strongest predictors of a sense of community, and a sense of community has been shown to improve life satisfaction, reduce loneliness, increase social support, and act as a protective factor against psychological distress[173,174,175].

Residents in a US public housing estate with good access to green common areas were found to have more social activities and visitors, know more of their neighbours, and report that their neighbours offer more help to each other, than people living near barren areas.

An attractive neighbourhood filled with trees and green spaces has been shown to foster stronger social bonds and engender a sense of community:

- The presence of trees and gardens in a public housing estate in Chicago was found to encourage people of all ages to spend more time outside and to gather around the trees. The more trees there were, and the closer they were to the residential building, the greater the number of people who gathered around them and the more time they spent there[176].
- In a similar vein, research showed that Dutch residents from low socio-economic backgrounds felt less lonely and experienced less social isolation when they lived in areas with more green space[177].
- And finally, residents in US public housing who had access to green common areas were found to have more social activities and more visitors, know more of their neighbours, and report that their neighbours were more interested in helping and supporting each other, than people who lived near barren areas[178].

Group green activities have been shown to improve both health and social outcomes:

- Groups like "Friends" groups and Landcare groups are a common form of Australian civic environmentalism, that is, where citizens volunteer together to solve an environmental problem in their community. Membership of these types of groups have been shown to increase people's sense of belonging and provide them with social help and support, which in turn lowers their stress levels[179]. Clearly, these groups, many of whom participate in National Tree Day, benefit both their members and the environment.

Community gardens have also been shown to foster social interaction and help develop and strengthen community ties. A study of a community garden scheme in a high-rise public housing estate in Sydney[180] found that the scheme increased opportunities for local residents to socialise and develop cross-cultural ties. It also developed a sense of peace and relaxation, and promoted happiness and personal renewal among residents.

Positive Action: Invite nature into your home and neighbourhood

Get a dose of nature every day and reap the financial, environmental, and health and wellbeing rewards that nature offers:

Clear the air

Use plants to clear toxins from the air in your house. One plant can clear the air in an average size room[181].

Stay cool

Use plants and trees to shade walls and windows from direct sunlight, and use ground cover and potted plants to reduce reflected heat from hard surfaces. Use trees to shade outdoor air conditioning units and improve their efficiency.

Grow a greener view

Plant trees, gardens, and planter boxes outside windows and glass doors so you can get the health and wellbeing benefits of views to nature.

Get the health benefits of views to nature at home by creating a beautiful garden you can see from your windows.

Even a few plants on your window sill can have a calming influence.

Plant a vegie patch

Grow a vegie garden in your backyard, on your balcony, or, if council permits, on your verge. Even growing some herbs on the window sill has benefits.

Get green with your neighbours

Get together with your neighbours to look after the streets, parks, or beaches – it will improve the environment, as well as your social life.

Create nature on the inside

Install plants around the house and decorate with cut flowers and artwork of natural scenes. Relax to recorded sounds of nature like birdsong or waves.

Get outside

Spend more time outside – on the balcony, in the yard, or at a park. Play with the kids, have a picnic, or work in your garden or at your local park.

Commute though nature

Green up your commute by parking the car, or getting off the bus, train, or tram a few stops early, and walking along some tree-lined streets or through a park.

VALUING NATURE AT SCHOOL

There is an ever-growing body of evidence demonstrating how beneficial – and indeed, essential – regular contact with nature is for children's health, wellbeing, and mental and physical development. In 2012, Planet Ark explored this evidence in its report, *Planting Trees – Just What The Doctor Ordered*[182].

With children spending a large proportion of their day at school, there is an increasing focus on how school environments impact on students and how connecting students with nature at school can help them perform at their best and get the most from their education experience.

The changing nature of school environments

In recent years, Australian schools have become increasingly vigilant about ensuring school grounds are as risk-free as possible. Litigation concerns have seen the removal of traditional play equipment like sandpits, swings, roundabouts, and see-saws, and more often than not, kids at school are discouraged or forbidden from doing activities freely enjoyed by previous generations of children, such as tree climbing, playing in the dirt, and even running, handstands and cartwheels[183]. Many school grounds, especially those with limited space, have removed or fenced off natural features like trees and gardens. Even grass is disappearing, with an increasing number of schools replacing grassed areas with artificial turf in a bid to reduce costs and extend playing time[184].

There are growing concerns though that the focus on creating risk-free school grounds and discouraging outdoor play may be hindering children's development and contributing to the rise of a range of problems in schools, such as bullying and other anti-social behaviour, and even physical injuries[185]. A recent Western Australian study found that primary school children are at increased risk of wrist and arm fractures in the schoolyard because a lack of play means they are missing out on important motor skills development[186].

Kids have been found to be at increased risk of fractures because a lack of play means they are missing out on critical motor skills development.

Despite the move away from more natural grounds and free play opportunities in many schools, research shows that, given a choice, children prefer to play in natural areas. An Australian study found that the natural / green area of a school's grounds attracted on average a higher number of students than manufactured play equipment and other constructed areas like paved sport courts and the canteen courtyard[187]. The natural / green area was also the only area to attract equal numbers of girls and boys.

Australian parents consider natural school grounds with real grass, trees and gardens to be as important as good academic outcomes and reputation.

It is not only students who prefer greener grounds; parents also value natural grounds at their child's school. The Planet Ark Valuing Nature Survey found

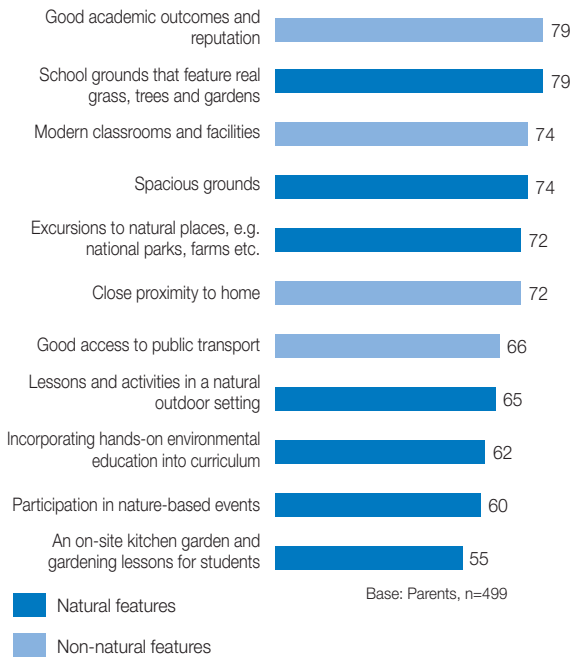


Figure 12. Percentage of parents who consider the listed features to be important qualities of the ideal school for their child.

that three-quarters of Australians (79%) consider natural school grounds with real grass, trees, and gardens to be important (Figure 12). In fact, parents view green school grounds to be as important as good academic outcomes and reputation. Parents also rated spacious grounds and excursions to natural places as highly as modern classroom facilities and closeness to home (Figure 12).

Bright green kids – The benefits of nature at school

In schools at all levels – early childhood, primary and secondary – interaction with nature has been shown to play a powerful role in helping students concentrate, enhancing cognitive performance, and improving student behaviour and attitude towards learning and their school.

In Canada, a survey of parents, teachers, and principals revealed that students and schools at all levels benefited significantly from school ground greening projects and outdoor learning initiatives[188]:

- 90% of respondents reported that student enthusiasm and engagement in learning increased on green school grounds;
- 72% reported that students were better able to retain knowledge;
- 77% reported that students were able to think more creatively;
- 39% reported that they had seen a positive change in student performance on standardised tests and / or improved mastery of curriculum standards;
- 72% reported that overall student pro-social behaviour (cooperative, respectful and non-violent) had improved;
- 70% reported that teachers' motivation for teaching had increased on green school grounds compared to teaching indoors.

Respondents also reported that green school ground initiatives reduced student discipline and aggression issues, lowered the incidence of "knock and bump" injuries, promoted cooperative and collaborative play, and increased students' environmental awareness and stewardship. Respondents suggested that student learning is enhanced on green grounds because natural areas are more meaningful and inviting places to learn, are less tightly regulated, and provide opportunities for students to be creative and engage their senses.

Students who participated in environment-based learning programs were found to perform better in reading, writing, maths, science, and social studies than their peers in traditional learning programs.

Similar effects have been found in other studies:

- In a US study, 92% of participating schools reported that students in outdoor, environment-based learning programs performed better in reading, writing, maths, science, and social studies than their peers in more traditional programs[189]. All schools (100%) reported that students in environment-based programs behaved better and had better school attendance and attitude than those in traditional programs. They were also better able than their peers to work in group settings, think creatively and critically, and solve problems.
- A Canadian study found a positive link between the presence of natural areas in a schoolyard and the academic performance of primary students, regardless of the socio-economic background of the school catchment area[190]. School greening was

found to have a stronger effect on achievement for students from poorer areas than for those from wealthier neighbourhoods.

- Larger windows and more views of nature from classrooms has been associated with students achieving higher standardised test scores, higher graduation rates, and a greater percentage of students planning to attend college[191], as well as less criminal behaviour. Conversely, school landscapes lacking in natural features, such as parking lots, had a negative impact on test scores and intentions to attend college. These findings persisted regardless of the socio-demographic and general characteristics of the school.
- A study of Melbourne primary schools found a wide range of perceived benefits of nature-based activities like tending gardens and native plants, and habitat restoration[192], including:
  - improved attitudes towards school and relationships with peers and adults;
  - more feelings of calm and less disruptive behaviour;
  - enhanced self-esteem and self-confidence;
  - increased sense of wellbeing, empowerment, and achievement.
- A classroom with six small trees was found to score significantly higher than a regular classroom on student preference, comfort, and friendliness. Students in the rooms with plants present also had far fewer absences due to illness and fewer punishment records than students in the regular classroom[193].

School ground greening and outdoor learning programs have been shown to help students concentrate, enhance their cognitive performance and creativity, and improve their behaviour and attitude towards school.

Green school grounds have been found to encourage light to moderate physical activity, while constructed areas like paved sports courts encourage sedentary behaviour.

Green school grounds have also been shown to increase the levels of physical activity among students. In a Canadian study[194], 66% of school staff surveyed reported that students use green areas for active play, and that green areas tend to encourage light to moderate physical activity. Another study by the same researchers[195] found that sedentary behaviour during recess and lunch periods was highest in constructed areas, such as paved sports courts and courtyards, and open asphalt areas.

Students in classrooms with six tropical, indoor plants experienced a 9% drop in health complaints, while students in rooms with no plants had a 12% increase in symptoms.

Poor air quality in classrooms is a serious problem in many Australian schools. A CSIRO study of a portable classroom renovated with new paint and carpet found that for three years afterwards, teachers and students reported headaches, nausea, sore throats, and increased use of asthma medication[196]. Even after three years, the total VOC level was still higher that the recommended level. Plants in classrooms have been shown to significantly improve air quality, reduce health complaints, and increase concentration. A Norwegian study found that students in classrooms with six tropical, indoor plants experienced a 9% drop in health complaints, while students in rooms with no plants had a 12% increase in symptoms[197]. Students in planted rooms also took less time off school due to illness and were better able to concentrate during school hours than their peers in regular classrooms. The study found that the plants reduced the concentration of total VOCs by 35%.

Positive Action: Invite nature into school

Help your students reach their academic potential, and improve their emotional and physical wellbeing, by greening up your school and connecting students with nature every day.

Take learning outside

Schedule learning time outdoors on a regular basis, whether in an outdoor classroom, the playground, or a park.

Link nature to the curriculum

Incorporate nature investigation or hands-on nature care activities into learning. Download lesson plans from the Schools Tree Day site.

Get digging

Create a vegetable garden and get children involved in planting and maintaining it.

Creating a food garden is a great way to encourage students to get their hands dirty, connect to nature, and make healthier food choices.

Take advantage of special days like Schools Tree Day to get students involved in nature-based activities like tree planting and habitat restoration.

Bring the outside in

Bring plants into your classroom to improve air quality and boost students' ability to concentrate. Just six large floor-standing plants in an average-sized classroom will make a difference[198,199].

Take advantage of "environment days"

Use key environment dates like Planet Ark's Schools Tree Day, Clean Up Australia Day, or World Environment Day, to get outside and plant trees or clean up the environment, or to run outdoor, nature-based excursions, such as a guided bush walk in a national park.

To support the achievement of online learning outcomes from Schools Tree Day, Planet Ark has developed a range of resources for schools, including lesson plans, games and activity sheets at: TreeDay.PlanetArk.org/schools.

Get into Nature. Grow.

national tree day
PLANET ARK TOYOTA

With Australians spending more and more time indoors, it is becoming increasingly important to our health and wellbeing that we find ways to connect with nature in our everyday lives – at work, at home, in our neighbourhoods, and at school.

As Australia's largest tree planting and nature care event, National Tree Day is a perfect opportunity to connect with nature and the community.

It is a safe and fun day out for everyone, giving people the opportunity to do something positive for the environment, join forces with their local community, and get the health benefits of connecting with nature.

With thousands of sites at schools, parks, gardens, and other locations across the country, National Tree Day and Schools Tree Day are perfect first steps to providing Australians of all ages with a dose of everyday nature.

This year, there are more ways than ever to get involved:

- Join the tens of thousands of people at hundreds of sites around the country who will be getting their hands dirty. All you need to do is find a site near you.
- Get your friends or family involved and take care of your yard or balcony, then register your activity so it gets added to the national total.
- Use the Tree Day Workplace guide to bring the benefits of nature to your work. Set up a garden or decorate your workplace with potted plants or nature images, then register your activity so it gets added to the national total.

For more information on getting involved in National Tree Day, visit TreeDay.PlanetArk.org.

National Tree Day is a wonderful opportunity for people of all ages to get into nature, connect with their local community, and do something positive for the environment.

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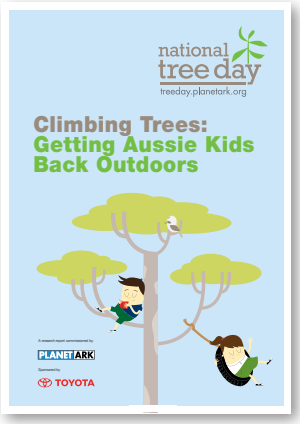
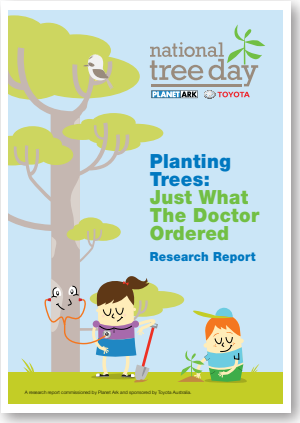
PREVIOUS PLANET ARK RESEARCH

Every year for the past three years, Planet Ark has commissioned independent surveys and produced reports in the lead up to National Tree Day, all focusing on contact with nature and outdoor recreation. The full reports and summaries of the key findings can be found at treeday.planetark.org/about/health-benefits.cfm

Planet Ark's 2011 report, ***Climbing Trees: Getting Aussie Kids Back Outdoors,*** explored the dramatic shift in Australian childhood experience from outdoor to indoor play over just one generation. The report was based on an independent study of Australians' attitudes, opinions, and recollections. It outlined the nature of children's outdoor play in Australia, the decline of outdoor activity in recent decades, and the perceived benefits of – and barriers to – outdoor play.



Planet Ark's 2012 report, ***Planting Trees: Just What The Doctor Ordered***, delved deeper into the intellectual, psychological, physical, and mental health benefits of contact with nature for children. It combined a review of current local and international academic research in this field, as well as the results of an independent attitudinal survey that provides an insight into how Australians perceive the link between nature and children's health, wellbeing, and development.



Planet Ark's 2013 report, ***Missing Trees: The Inside Story of an Outdoor Nation,*** focused on outdoor recreation and contact with nature, among adults as well as children. The report outlined the results of an independent survey that explored Australians' attitudes, opinions and behaviour in regards to: the backyard and its decline in Australia; whether the great outdoors is still a key part of how we view ourselves as Australians; and whether there is a link between backyards and the amount of time people spend doing outdoor recreational activities. The report also includes references to a number of relevant external studies.