

Wildlife gardening, nature and education – the evidence reviewed

Steve Head

There is now a tremendous body of evidence that children's development and education at all levels benefit greatly when some of it can be delivered in an outdoor semi-natural environment, where children are exposed to natural physical and biological influences, and can let their imaginations run free.

Relatively little evidence is *specific* to school or home wildlife gardening, but maintaining semi-natural wildlife friendly areas for teaching and/or informal play are providing precisely the conditions which have been shown to benefit behaviour, health, concentration and learning. Please read this document as evidence for the importance of outdoor play, experience and learning. School grounds and wildlife gardens are easily available, cost effective and practical places to provide it.

We review evidence at several levels:

1. [Biophilia and poor human adaptation to cities](#)
2. [Loss of connection with nature](#)
 - 2.1. ["Nature deficit disorder"](#)
 - 2.2. [Changes in play](#)
 - 2.3. [Electronic media](#)
 - 2.4. [Disadvantaged children](#)
 - 2.5. [Loss of natural history skills](#)
3. [General benefits of outdoor play and experience to children](#)
 - 3.1. [Activity levels and physical health](#)
 - 3.2. [Obesity](#)
 - 3.3. [Mental wellbeing](#)
 - 3.4. [Attention Deficit Hyperactivity Disorder](#)
 - 3.5. [Personal and social skills](#)
 - 3.6. [The special role of biodiversity in green space benefits](#)
4. [Learning benefits of outdoor education](#)
 - 4.1. [General benefits](#)
 - 4.2. [Conservation based learning](#)
 - 4.3. [School gardening programmes](#)
5. [Persistence of outdoor learning benefits into adult life](#)
6. [Barriers to outdoor education](#)
 - 6.1. [Parental concern over of traffic accidents](#)
 - 6.2. [Perception that risks are all outside the home](#)
 - 6.3. [Stranger danger](#)
 - 6.4. [Over-cautious authorities](#)

- 6.5. [“Don't-touch” conservationists](#)
- 6.6. [Special case of teenagers](#)
- 7. [Conclusions](#)
- 8. [References](#)

1. Biophilia and poor human adaptation to cities

The Biophilia hypothesis¹ was adapted by the great American naturalist Edward O. Wilson to explain many apparent innate human preferences (and phobias) in an evolutionary context. *Homo sapiens* evolved in Africa between about 350,000 and 260,000 years ago² in a time of climatic variability and a mixture of habitat types. The resources early humans used were all natural – animals and plants for food, materials for tools and shelter, and large and small dangerous animals and poisonous plants to avoid. Humans would have needed a mental toolkit to increase their chances of survival. Even now, we are apparently genetically predisposed to fear snakes and spiders, and to enjoy building “dens”³ and generally to feel comfortable in green environments.

According to Wilson, our brains evolved to process the natural environments in which our ancestors lived, leading to built-in tendency to respond positively to the natural “outdoor” environment. This is how humans would have lived for nearly all their history.

The first permanent settlements appeared only about 12,000 years ago with the Natufian culture in the near east, but even these may have been only seasonally occupied. Permanent settlements were found in the early Neolithic of the middle east, such as Jericho about 10,000 years ago⁴. The first city in the modern sense with over a million inhabitants was Rome about 100AD while in Britain, London rose from about 1.3m in 1825 to 7.4m in 1914⁵.

The very recent (in evolutionary terms) adoption of the highly unnatural urban environment was made by humans whose brains were wholly un-adapted to this crowded, fast moving and concrete-dominated environment. It is interesting that most city dwellers are stressed⁶, and many urbanites choose countryside retreats or unspoiled seaside for vacations.

There is some neurological evidence that our brains are badly adapted for city life. A recent study showed that similar sounds (waves on a beach and highway traffic) were processed with better connectivity to the parts of the brain associated with mental states if the image presented at the same time was natural (beach) compared with unnatural (highway)⁷.

A meta-analysis of 110 papers by Dutch authors found that the prevalence of mental disorder was higher in urban areas compared with rural areas for the categories “any disorder” (38% higher), mood disorders (39%) and anxiety disorders (21%). Even after controlling for a relatively large number of other factors, the urban environment seems to be associated with the prevalence of psychopathology⁸.

A study following up records of over 4 million Swedish people found that with increasing levels of urbanisation the rates of psychosis and depression rose. People living in the most densely populated areas had 68–77% more risk of developing psychosis and 12–20% more risk of developing depression than the reference low urbanisation group. The authors

concluded that a high level of urbanisation is associated with increased risk of psychosis and depression for both women and men⁹.

To learn more about the evidence for Biophilia and human response we recommend William Birds 2007 review¹⁰. Hypotheses as far reaching as Biophilia are hard to test directly – we can only look at modern people and their brain function. However, we have had a negligible time in evolution terms to adapt from rural extended family living to a modern intense urban environment, and there is plenty of evidence that this modern environment is bad for us.

Currently 54% of the world's population live in towns and cities, having risen from 30% in 1950. By 2050, 66 per cent of the world's population is projected to be urban¹¹. It is essential we apply ideas stemming from the Biophilia hypothesis to city living and bringing up our children.

2. Loss of connection with nature

2.1 “Nature deficit disorder”

As more people adopt fully urban lives, they are becoming increasingly cut-off from natural environments, living in unnatural cities with little exposure to the natural environment in which our species evolved. Children today are experiencing nature far less than ever before in history.

In a far reaching and passionate account of the modern disconnect from nature Robert Pyle described a cycle of loss and disaffection he called the Extinction of Experience .

“Essentially, the extinction of experience syndrome works as follows: when common species of plants and animals (as well as cultural, architectural, or any other features of diversity) become extirpated in one's everyday environs – within, that is, one's radius of reach – one grows increasingly inured to their absence”¹²

Another term you will encounter is “Nature deficit disorder” coined by Richard Louv in his influential book “Last Child in the Woods” recognising that people, especially children, are spending little time outdoors, resulting in a wide range of problems¹³. The term is not medically recognised, but intended to serve as a short-cut for the consequences of our alienation from the natural world.

2.2 Changes in play

To get a clear idea how children's experience has changed we can look at a 2009 study for Natural England¹⁴ which set out to understand (and explain) differences between the freedom given to today's generation of children to play unsupervised in natural places compared to that of previous generations. The survey covered most regions of the UK, and the adult findings were split between young (current parents) and older (grandparents).

Modern children spent much less time playing in natural places, such as woodlands, countryside and heaths than did previous generations. Less than 10% play in such places compared to 40% of adults when they were young.

Percentage of children playing in different areas	Modern children	Parents' generation	Grandparents' generation
At own or friends home	82%	78%	73%
In local streets	40%	74%	80%
School playground	40%	64%	58%
House garden	75%	78%	73%
Woods	10%	44%	52%
Heath, field, farmland	9%	39%	49%
Riverside, canalside, pond	7%	22%	33%
Moorland, mountain, wild places	4%	11%	18%

The most popular place for children to play (see below) is now the home, while for adults it was outdoors in local streets. Natural areas, barely register as favourite places to play for modern children and the data suggest that they rarely have an opportunity to go to these places. Although over half of adults used to visit a local patch of nature at least once a week, less than a quarter of children now do so.

Favourite places to play	Child	Adult
At home or my friend's home indoors	41%	16%
Indoor activity centre	6%	1%
School playground	3%	2%
Indoor after school club	2%	1%
Indoor sports centre	3%	1%
In the streets near my home	14%	29%
Garden	17%	12%
School playing fields	2%	2%
Outdoor adventure playground	6%	3%
Woods	2%	15%
Heath / Fields / Farmland	2%	10%
Riverside / Canalside / Pond	1%	4%
Mountains / Moorland / Other wild spaces	0%	2%

Parental supervision levels have hugely increased since the parent's generation, especially in natural places.

Reported supervision levels in different play areas	Children	Adults
At home or my friend's home indoors	86%	65%
Indoor activity centre	93%	90%
School playground	87%	75%
In the streets near my home	31%	9%
Garden	52%	32%
School playing fields	83%	54%
Outdoor adventure playground	76%	47%
Woods	67%	13%
Heath / Fields / Farmland	70%	11%
Riverside / Canalside / Pond	86%	14%
Mountains / Moorland / Other wild spaces	80%	27%

Although 81% of children and 85% of parents would like more unsupervised play in natural places, concerns over stranger danger, and road safety were dominant barriers. That 12% of children didn't even know if they would like to play outside more, suggests that some have very little experience of outdoor play.

Even everyday routine has changed. The number of children walking to school is steadily falling. In 1989-91, 62% of primary aged children walked to school, compared to 54 in 1999-2001. For secondary children, 53% walked or cycled to school in 1989-91, down to 45% in 199-2001. Much of the drop was taken up by travel in private cars, greatly adding to term-time road congestion¹⁵.

2.3 Electronic media

As play outdoors has diminished, the attractions of indoor electronic media and activities have more than taken over. Stephen Moss's excellent review "Natural Childhood" for the National Trust notes that

*Children today do not explore their environment in person, they are increasingly at home only in the digital world. They watch television for 17 hours, and are online for 20 hours every week. Our 11–15-year-olds spend half their waking lives in front of a screen.*¹⁶

American children now use electronic media on average about 53 hours week, or over seven hours each day¹⁷. The over protected indoor life of children has been called 'well-meaning, protective house arrest'¹⁸.

As well as being at second hand, the vicarious experience of nature through media is downgrading in diversity and extent. In an unusual study researchers¹⁹ used Disney and Pixar animations to assess changes in attitude to green space assuming that the representation of green nature movies reflects the filmmakers' own relationship with nature and their perception of their audience's expectations.

They found that the proportion of scenes depicting outdoor nature had decreased significantly with time, roughly halving between 1940 and 2010. The relative duration of “tame” scenes in gardens or agricultural settings increased but not statistically significantly. The number of animal species drawn in settings (excluding central characters) dropped highly significantly in the same period from about 19 to 4.

Now that second-hand (electronic) experience of “nature” is replacing first-hand experience, the finding that nature is now represented with less biodiversity and realism threatens the involvement of future generations in environmental issues.

2.4 Disadvantaged children

Unsurprisingly, the disconnect from nature is more acute in disadvantaged children and differs between rural and urban environments. In a remarkable survey in 2004 by the Green Alliance and Demos many of the rural children interviewed came from more affluent families than the urban children - but the underlying inequality was in overall levels of deprivation and its impact on children’s access to quality space. The children from more affluent backgrounds in rural areas generally had large gardens, and had access to farms or fields. Many had equipment in the garden such as trampolines, ponds or sheds. Children from disadvantaged backgrounds in urban areas lacked access to outdoor space at home or school. When available, shared garden space was often undermined by problems such as nettles or noisy neighbours²⁰.

Professor David Orr has questioned the role of the commercialisation of childhood in this decline. He notes that:

*“we have little idea of the long-term effects of excessive materialism on the child, but it is reasonable to think that its hallmarks are satiation, shallowness, and the loss of deeper feelings having to do with a secure and stable identity rooted in the self, relationships, and place”*²¹

2.5 Loss of natural history skills

The issue of disconnect from nature becomes a national problem when it comes to a decline in the ability of British students to name or classify common wild species. A study in 2002 compared primary school children’s ability to identify pictures of common British wildlife with identifying Pokemon card. While 78% could identify Pokemon characters, only 53% were successful in identifying wildlife²².

At secondary level, 800 “A” level biology students proved very poor at recognising and naming 10 common wild flowers, and 86% could only name three or less. Trainee teachers performed little better and nearly a third of the practicing A-level biology teachers tested were able to name only three or fewer wild flowers.²³ Identification skills are vital for the next generation of ecologists and conservationists, and there is great concern about the national decline of taxonomic skills²⁴

In “A child’s place” authors Gillian Thomas and Guy Thompson summed up the concern very well:

The paradox is that we are fostering a generation that is likely to face the toughest environmental challenges yet, in terms of climate change and the ever-increasing pressure on natural resources. This generation, more than any other before, will need the environmental awareness and citizenship that is instilled through exploration in childhood.²⁵

3. General benefits of outdoor play and experience to children

One of the most basic reasons why access to and play in the natural environment contributes to children's well-being is that they can indulge in "letting off steam, shouting and running". Other benefits include quiet reflection, confiding in others and being with family members and pets²⁶. It really is about children being able to behave naturally like children.

The benefits are in terms of physical and mental wellbeing, concentration and personal and social skills.

3.1 Activity levels and physical health

Inactivity in adults as well as children has become a major health issue. In an excellent 2009 review²⁷ Essex academics noted that our physical activity levels have dropped dramatically, and that inactivity results in 1.9 million deaths globally every year, or 4% of the total. They estimate the costs in the UK amount to £8.3 billion per year, or about £5 million for every Primary Care Trust.

There is plenty of evidence that children are more active, exercise harder and enjoy exercise much more when they can do it in a personal and creative way out of doors, and it improves their motor skills and coordination.

A Danish study measured primary school student's activity levels over three years during outdoor learning days in a Forest School, and compared them with both traditional school days, and traditional school days which including two physical education lessons. The mean activity levels were more than twice as high on the forest days measured in winter and summer compared with traditional school days, and equal to traditional days with two PE lessons. The study demonstrates a significantly higher level of physical activity when indoor and outdoor learning contexts are combined and from a physical health perspective, outdoor learning is recommended.²⁸

A similar Norwegian study compared two groups of primary age children, one taught in a stimulating forest school environment, another in a traditional classroom. A large area of forest and steep slopes formed a "natural playscape" with different areas and types used in different ways by the children. Play types included;

- a) functional play – running, sliding and climbing,
- b) constructive play - building huts and shelters and
- c) symbolic play – role play, drama enactment, playing pirates.

The play mode was decided by individuals and collectively by groups. Motor skills were measured with the demanding European Test of Physical Fitness (EUROFIT) Motor Fitness

Test. It was found that physical activity play in the natural environment improved all the motor abilities tested, except for flexibility, and significant differences between the experimental group and comparison group were found in balance and coordination abilities.²⁹

Similar evidence of motor skill improvement was recorded in a German study, which compared large groups of 5 ½ year old children in forest school, rural and urban kindergartens. It showed that children who attend forest kindergartens achieve better motor performance than children in regular kindergartens.³⁰

What is it that children find attractive in natural environments? In a classic study Wendy Titman listed children’s preferences for different aspects of outdoor play environments³¹.

Elements children liked	Elements children disliked
Colour (natural)	Colour (un-natural)
Trees	Dirt
Woods	Pollution
Places with different levels	Rubbish
Shady areas	Damaged things
Leaves	Litter
Big grassy areas	Tarmac
Animals (generally)	Animals (farm animals for urban children)
Places you can...climb/ hide/explore/make a den	Places where you can't...
Places that challenge you	Nowhere to sit/hide/shelter
Places that have 'millions of bits'	Places that are 'boring'
Places that have wildlife	Places that are too 'open'

Children clearly have a desire for more complex, challenging and exciting play environments than those provided by traditional playgrounds. This was beautifully exemplified by a quote from one child:

"We go into the woods and build dens and swings. I like climbing, it's wicked. On a playground you know it's safe so it takes the fun out. When you're climbing a tree you can use your imagination more. Playgrounds just hinder you."

Relevant to the list above, is the special fascination of secret private spaces which are particularly important to children. They tend to be semi-hidden places where children feel safe, not too far away from their home, whilst being flexible in use and valid for different sorts of play. Examples included the bottom of the garden and local disused parkland. The unofficial nature of these spaces enabled children to imagine and use them with their own distinct personal meaning³².

Young children playing outdoors show a strong attraction to natural shelter-like structure. One study noted how children were attracted to a “scruffy” playground area overgrown with shrubs, where over some years they had created tunnels, pathways and small rooms³³. The children were devastated when a well-meaning parental tidying-up-weekend returned their natural playground to bare grass. The same study found that children’s imaginative/dramatic play was 60% greater in natural structure settings than built structures.

3.2 Obesity

The importance of active outdoor play to reducing childhood obesity is now well established. The UK Government's paper "Childhood obesity: a plan for action"³⁴ revealed some stark facts. Today nearly a third of children aged 2 to 15 are overweight or obese³⁵. Among reception year children 9% are clinically obese, rising to 20% in Year 6 students³⁶. Younger generations are becoming obese at earlier ages and staying obese for longer³⁷. Reducing obesity saves lives as obesity doubles the risk of dying prematurely. The burden is falling hardest on those children from low-income backgrounds. Obesity rates are highest for children from the most deprived areas and the problem is getting worse³⁸.

Obesity is caused by an energy imbalance: taking in more energy through food than we use through activity. Physical activity is associated with numerous health benefits for children, such as muscle and bone strength, health and fitness, improved quality of sleep and maintenance of a healthy weight³⁹. While much of the Government strategy to reduce childhood obesity centres on food quality and reduction of sugary foods, it also supports the UK chief medical officer's recommendation that all children and young people should engage in moderate to vigorous intensity physical activity for at least 60 minutes every day. There will also be investment in walking and cycling to school and into in to projects which offer new opportunities for families and children to get active and play sport together.⁴⁰

Where children live has a strong impact on their weight. An American study tracked the body mass index (BMI) of 3,831 children over two years. Children living in greener areas had a lower BMI and gained weight more slowly over the study period. Sixteen-year-olds, for example, were roughly 6 kilograms lighter in the greenest compared to the most urban neighbourhoods.⁴¹ The effect was not related to either the wealth of the children's families, or their housing density, ruling out the effects of diet or amount of space available. The study concluded that children are more likely to play physically and exercise if their surroundings include plenty of green space.

Governments urge us all to take more exercise, which could be in a gym, or walking upstairs rather than taking the lift. In his 2004 review of physical fitness and the benefit of green space and biodiversity⁴² Dr William Bird showed that people who take exercise in green space are much more likely to persist with their healthy activities because they *enjoy* the experience.

"Local access to safe natural green space and attractive scenery is associated with high levels of physical activity within communities. Research on two national schemes show that health reasons motivate people to join, but experiencing close contact with nature becomes the more important factor in maintain levels of physical activity. Activities in which exercise becomes secondary to environmental or social benefits (e.g. cycling, gardening, Green Gym, walking in green space and many sports) appear to be more sustainable than activities in which exercise remains the primary driver."

3.3. Mental Wellbeing

Children's mental health in Britain is becoming a matter for considerable concern. A 2007 report by William Bird for the RSPB notes⁴³:

- One in 10 boys and 1 in 18 girls aged 5-10yrs have a diagnosed mental health disorder.
- Those children aged 11-17yrs have higher levels, 1 in 8 for boys and 1 in 10 for girls.
- Those at highest risk are those in lower social class and young offenders.
- More than 40,000 children now use anti-depressants, following a sharp rise over the past 5 years.
- In 2002, there were 29,400 female suicide attempts and 14,500 male suicide attempts in young people under the age of 25 yrs.
- A recent study has placed Britain 21st out of 25 European States for wellbeing in children. They have poorer relationships, engage in riskier behaviour and suffer from worse health than their European counterparts.

Bird lists several problems for which contact with nature can help, including:

- Treatment for children with poor self-discipline, hyperactivity and Attention
- Attention Deficit Hyperactivity Disorder (ADHD).
- Healthy cognitive development of children.
- Concentration levels in children and office workers.
- Strengthened Communities
- Strategies to reduce crime and aggression
- Stress
- Increased sense of wellbeing and mental health

He suggests three mechanisms for how nature affects our mental state, starting with E.O. Wilson's Biophilia theory discussed above, in addition to:

- *Attention Restoration Theory* suggests our brains become exhausted by forced attention on boring but important subjects, and that the natural environment allows our attention to wander where we wish "allowing our brain to recharge".
- *Psycho-physiological Stress Recovery Theory* is based on the immediate positive effects that views of nature have to reduce blood pressure, heart rate and muscle tension. It suggests we are programmed to "take it easy" in safe natural surroundings, and that like Biophilia, there is a deep genetic component.

It is likely that Biophilia explains the "why" of our innate response to nature, while the other two theories account in some way for the "how".

That nature can mitigate stressful life events in a child's life was shown by a study in New York. In a rural setting, the presence of nearby nature moderates the impact of stressful life events on the psychological well-being of children, judged by their parents and in terms of their own self-worth. Specifically, the impact of life stress at low, medium and high levels

was lower among children with high levels of nearby nature than among those with little nearby nature⁴⁴

Forest schools appear to be very effective in improving aspects of mental well-being and behaviour. An important study by Jenny Roe and Peter Aspinall compared the restorative outcomes for 11 year olds when spending time in an outdoor forest school versus a conventional indoor school setting. Their general behaviour had been assessed and varied from 'good' to 'poor'. Two aspects of restorative function were examined, mood (measuring energy, stress, anger and ability to experience pleasure), and reflection on personal goals. The results showed a number of significant beneficial effects in the forest setting. Furthermore, the children with poor behaviour benefitted significantly more from the forest school experience than the other children⁴⁵.

3.4 Attention Deficit Hyperactivity Disorder

Attention Deficit Hyperactivity Disorder (ADHD) affects 5-10% of 6-11yr olds. It shows in three ways – overactive behaviour, impulsive behaviour, and difficulty in paying attention, resulting in them underperforming at school. Their behaviour often makes them disliked and alienated from other children. ADHD is routinely medically treated by drugs like Ritalin and antidepressants, with 350,000 UK prescriptions for Ritalin and similar drugs in 2004⁴⁶

There is increasing evidence that contact with nature can be very effective in managing ADHD. In a much quoted experimental American study 7 to 12 year olds with ADHD were given individually guided 20-minute walks through a leafy city park and two other walks in well-kept urban settings without green space. Not only did children concentrate significantly better after the park walk than the urban walks, the improvement was similar to that achieved by methylphenidate (Ritalin). The authors concluded that “Doses of nature” might serve as a safe, inexpensive, widely accessible new approach in the tool kit for managing ADHD symptoms⁴⁷.

This experimental study extended the results of a previous questionnaire-based survey which suggested that green outdoor activities reduced ADHD symptoms significantly more than did either built outdoor activities or indoor activities⁴⁸. This was consistent regardless of age, sex, family income, severity of condition, and whether from urban, suburban or rural homes

3.5 Personal and social skills

Although harder to measure than health and behaviour changes, experiences with nature have been shown to benefit children's social and personal skills, leading for example to reduced bullying.

An American study found that tough and “physical” children dominated in play areas containing man-made play structures, creating a social hierarchy by physical competence. In contrast an open grassy area was planted with shrubs encouraged different and more varied play, with imaginative or fantasy play and greater socialisation. Instead of physical strength the social hierarchy became based on a child's creativity and command of language and their inventiveness in imagining what the space might be used for⁴⁹.

A major Australian study on playground functionality found a relationship between the density with which children are packed into plain tarmac play areas and the incidence of aggressive bullying behaviour. The only school without a bullying problem was the only non-urban school, in a 12 hectare idyllic rural setting, complete with a mature pine forest, providing a highly interactive and engaging environment. The authors considered that conflict over space use and the impact of crowded and “boring” play spaces are significant factors when considering ways to reduce bullying.

“destructive behaviour is sometimes encouraged by...large, boring, open play areas, where space is not broken up by trees, low bushes, hedges or other natural boundaries... environments like this, which often incorporate little or no natural shade make it impossible for small peer groups to get away from others, and find quiet restful spots⁵⁰”

Reporting on their outdoor educational project developed with a group of pre-school children Portuguese researchers concluded:

“We have realized that outdoor play allows for a deeper knowledge about children, facilitating a more adequate educational intervention from the adult. Likewise, fewer conflicts occur during outdoor play and children tend to cooperate more with each other.... The characteristics of the space (open and unpredictable) enable the development of joint goals between children, leading to experiences of companionship among peers.

During outdoor play, children become teachers and learners, sharing their knowledge and skills to accomplish different tasks or challenges. In this process of cooperation, it is possible to develop empathy, as children begin to understand other people’s feelings and needs. The crucial difference about socialization in the outdoor environment is that opportunities for interaction happen in a gradual way, giving children the possibility to choose the moments to connect with others or to play individually, without having to continually run into each other as it so often happens in small enclosed rooms.⁵¹”

At the other end of the age range, teenagers are often left out of consideration for outdoor play. In a report for Natural England⁵², Catharine Ward Thompson and colleagues detailed the ways in which this age group can benefit from challenging, often organised outdoor projects and experience. Ward Thompson used the attractive phrase “Wild Adventure Space” for what works well for teenagers, and detailed the benefits as:

- Personal development in terms of raised self-confidence, independence, self-esteem and sense of achievement. Many disadvantaged young people are leaving home at 16 and need this confidence.
- Development of practical skills, such as construction, woodworking, or conservation techniques
- Development of social skills, such as getting along with others, negotiation skills and team working
- Development of physical skills.
- Widening of horizons, developing aspirations and improving employment prospects
- Giving breathing space to young people allows them to have fun away from everyday pressures of family, peer groups, and school.

- Environmental awareness
- Wild adventure space activities give opportunities for increasing awareness and understanding of diversity between cultures

One of her teenage focus group members commented tellingly:

“People have stereotyped teenagers – there are no play areas for teenagers”.

3.6 The special role of biodiversity in green space benefits

Although the health, wellbeing and social benefits of exposure to green space are clear⁵³, the particular role of biodiversity within the whole picture has been studied much less.

In his review of physical exercise and outdoor space, William Bird noted that nature is a major motivating factor for exercise. Wildlife-rich gardens can help increase physical activity in sedentary and vulnerable patients or residents. More generally biodiversity can give extra benefits to people engaging in physical activity. Being in the countryside is an important motivator, but this is due to variety both by time (seasons) and space (biodiversity). The more wildlife-rich the green space, the more varied it is perceived as being.

User surveys show that one measure of the attractiveness of a green space is the amount of nature it can offer to the visitor, and this is the main reason why someone would chose to take exercise in a specific park that is not their closest park. For many people exercise has been shown to be simply a method of travelling to, and engaging with, the benefits of nature⁵⁴.

The most important recent study was based on 15 public greenspace areas in Sheffield, involving 312 users of the green spaces. The sites were assessed for habitat types, plant, butterfly and bird diversity, and interviews conducted to measure how people perceived the biodiversity of the sites, and how they rated the sites for inner reflection, recovery from fatigue and emotional response.

Interviewees subjectively estimated plant diversity very well, birds poorly, and butterflies not at all. The number of habitat types, plant diversity and bird diversity were positively related to several psychological well-being measures, and these were more powerful factors than the area of the site alone.

The positive relationships between the habitat diversity of the sites and both perceptions of diversity and psychological benefits revealed that variety of habitat structure is an important controlling factor. This immediately suggests that managing public green spaces as mosaics of different habitats will not only enhance biodiversity but also the well-being of the city dwellers.⁵⁵

This importance of spatial diversity for people as well as wildlife was described in another Sheffield University study which concluded that public open spaces should be planned as networks of varied linked spaces. This arrangement has high restorative potential, facilitates social interaction and encourages contemplative psychological responses. Spaces should be special and significant in their own right but not perceived as detached, so that as one moves through them they are seen as mosaics with separate components that link into larger, more

complex wholes. They should induce reflection and contemplation; link mental and physical worlds and allow the mind to wander⁵⁶.

4. Learning benefits of outdoor education

4.1 General benefits

According to the National Environmental Education and Training Foundation in the US, when schools make a strong effort to integrate natural environments into their teaching, using local areas or their own school grounds, academic performance improves across the curriculum⁵⁷.

In her 2002 Master's thesis Michelle Simone explored the relationship between student achievement (measured by standardised tests) and schoolyard naturalization in elementary schools in Canada. It also examined whether the relationship remains when socio-economic background factors were taken into account. Simone found a positive relationship between schoolyard naturalization and student achievement especially for Grade 3 students, and perhaps unsurprisingly, strong relationships between the socio-economic background of the school catchment area and both student achievement and schoolyard naturalization. Significantly however the relationship between student achievement and schoolyard naturalization remained when socio-economic background is controlled. Furthermore schoolyard naturalization appears to have a stronger effect on achievement for students from poorer neighbourhoods than for students from wealthier neighbourhoods.⁵⁸

We saw above that concentration in children with ADHD can be enhanced through quite short periods of outdoor experience, and that, because children like being outdoors, they are more lively and active. It seems however that outdoor education can be *qualitatively* different from classic classroom based learning, and that it does not merely improve what children can absorb, but how they do so.

In their publication *A Child's Place: why environment matters to children*⁵⁹ Gillian Thomas and Guy Thompson found the learning outcomes from outdoor activities included:

- communicating and negotiating with others
- responsibility for others (e.g. younger siblings)
- curiosity in living things
- story-telling, magic and myths (especially in relation to secret spaces).

Another study suggested outdoor education gives rise to “changes in thinking, feeling and/or behaviour resulting directly or indirectly from outdoor education”⁶⁰. The authors listed four types of impact:

- Cognitive Impacts – concerning knowledge, understanding and other academic outcomes.
- Affective Impacts – encompassing attitudes, values, beliefs and self-perceptions.

- Interpersonal and Social Impacts – including communication skills, leadership and teamwork.
- Physical and Behavioural Impacts – relating to physical fitness, physical skills, personal behaviours and social actions.

While only the cognitive impacts may at first appear to be directly learning-related, the other three impact on the child’s overall sense of worth and ability to participate fully in school activities.

An important review of all forms of out-of-classroom activities (including field trips and outdoor adventure activities⁶¹ concluded that

“Substantial evidence exists to indicate that fieldwork, properly conceived, adequately planned, well taught and effectively followed up, offers learners opportunities to develop their knowledge and skills in ways that add value to their everyday experiences in the classroom”

In the case of school grounds and community projects the review considered benefits included:

- linkage with most curriculum areas.
- positive gains in science process skills
- improved understanding of design and technology-related issues.
- Gives children include greater confidence ... stronger motivation toward learning
- Students develop more positive relationships with each other, with their teachers

To summarise, evidence for the learning benefit of out-of-door experience is so strong that in their conclusions from the Teaching and Learning Research Programme, Mary James and Andrew Pollard stated that :

“informal learning , such as learning out of school, should be recognised as at least as significant as formal learning and should therefore be valued and appropriately utilised in formal processes”⁶²

4.2 Conservation based learning

A couple of studies have been able to relate conservation-based outdoor learning explicitly to learning gains. An American study of children involved in hands-on action to assist migrating amphibians found that “students who had taken part in conservation action performed significantly better on achievement tests and expressed high interest and wellbeing and low anger, anxiety, and boredom” than students who had been taught using only traditional Methods.⁶³

Another study described the impact of a five-week intervention in which students aged 8-10 were taught how to write a field-guide to identify plants in a small area of woodland near to the school. The authors found that students “came to understand and care for the natural world in their immediate environment.”⁶⁴

With the realisation that urban gardens (and therefore school grounds) are of increasing importance in conserving non-specialist species, more outdoor work in schools could usefully

focus on understanding conservation through exploring local biodiversity. It would be of great interest if such interventions could be monitored and evaluated for learning benefits.

4.3 School Gardening programmes

One of the commonest outdoor environmental exercises in British schools involves children gardening in dedicated plots, often growing and learning about food crops. In general terms, Dana Miller⁶⁵ wrote:

"Involving children in gardening at an early age gives them the opportunity to develop a sense of wonder about the world and be amazed every day with each new discovery."

The Royal Horticultural Society report "Gardening in Schools: A Vital Tool in Children's Learning"⁶⁶ identified "Three Rs" as benefits of school gardening:

- Ready to Learn - enhanced core skills and encouraged children to take greater control of their own learning and become more active in seeking knowledge and solving problems.
- Resilient - boosting self esteem and confidence, learning to cope with setbacks, improved concentration
- Responsible – encouraged healthy eating, responsible behaviour, flexibility of approach social skills and community responsibility

The RHS continue to run their "RHS Campaign for School Gardening" through the website <https://schoolgardening.rhs.org.uk/home>.

As with many aspects of education, published quantitative evidence evaluating the benefits school gardening interventions is not overwhelming.

American research has shown that hands-on growing of a variety of vegetables by primary children significantly improved their knowledge, and much improved their attitude to healthy eating through vegetable consumption.⁶⁷

Karen Block and colleagues used both subjective qualitative and test-based quantitative approaches to evaluate the benefits of a structured gardening and cooking programme in Australia⁶⁸. Children's engagement and confidence were strongly boosted, and they greatly valued and looked forward to their "kitchen and garden days". They all liked the kitchen experience, and for example being trusted to "use real chef's knives".

They were more variable in their approach to the gardening side, some needing high levels of encouragement and disliking heat/cold/dirt. For others, the sense of achievement of creating something from bare earth was very satisfying. These qualitative benefits did not show through to quantitative measures of absenteeism or well-being.

Teachers found the programme particularly beneficial for non-academic children, and those with degrees of autism or learning difficulties, because it provided a “level playing field” through hands-on learning. Initial concerns that it would detract from classroom core learning were allayed because the programme boosted curriculum integration. Again however, these benefits were not reflected in quantitative outcome measures.

The programme was felt to enhance social connections within the classroom, school, parents and community, and the garden created raised the aesthetic appeal of the school environment. The need for volunteering and fund-raising was very effective at involving the community, and engaging grandparents and otherwise reticent parents with poor English skills. Yet again unfortunately, these very positive qualitative measures were not matched by quantitative assessment.

The authors did not dispute the powerfully expressed subjective benefits noted by children, teachers and parents, and advocated a spreading of the principles to other schools using specialist staff. The discordant results from standard quantitative measures suggested better measures may be needed to evaluate longer term, more subtle benefits.

A British randomised controlled trial specifically investigated the impact of school gardening on the children’s consumption of fresh produce. The results have found very little evidence that school gardening on its own can improve children’s daily fruit and vegetable intake. There was some evidence that when gardening is implemented at a high level within the school it may improve children’s daily fruit and vegetable intake by a portion. The authors concluded “Improving children’s fruit and vegetable intake remains a challenging task”⁶⁹

5. Persistence of outdoor learning benefits into adult life

We have seen above that many of the proven benefits of outdoor, nature and biodiversity linked education lie in the way these approaches aid the overall development of the child and their overall ability to learn. Given the tendency most of us have to forget academic knowledge like algebra and French grammar shortly after leaving school, is there evidence that environmental education at school has an impact on attitudes to nature that persist to adult life? Reassuringly, such evidence exists.

Two British researchers looked at various emotional connections adult students had with different environments, which included positive feelings they termed *eudemonia* and negative feelings of apprehension. People with a rural childhood, and those reporting greater prior experience of the natural environment tended to report greater *eudemonia* and less apprehension in relation to the test environments compared to less experienced participants with an urban childhood location. The authors saw this as reinforcement of the idea that biophilic, (and to some extent biophobic), predispositions may be awakened or enhanced through experience of the environment.⁷⁰

In a study embracing all stages of life Jules Pretty and his colleagues found evidence to show that children's contact with nature and consequent levels of physical activity affects not only their current well-being but goes on to affect their health in later life. They hypothesised two diverging pathways, in which children with free-ranging outdoor experience gain strong brain development and become people who remain active, are connected with other people and society, eat healthily and continue to engage with the outdoors. They have lower blood pressure and cortisol levels, and tend to live longer.

In contrast, children denied childhood outdoor opportunities tend to grow into inactive adults, disengaged from people, society and nature, and eating unhealthy foods. It was suggested they tend to have higher blood pressure and cortisol levels, and die younger.⁷¹

A retrospective study used questionnaires to explore the frequency of British adults' visits to green places, and compared this with how often they visited natural places as children. The study found a strong relationship between frequent childhood visits and being prepared to visit woodlands or green spaces alone as an adult. By contrast, not visiting as a child was associated with a very low likelihood of later adult visits. The data also suggest that the physical and the emotional benefits of access to green space are strongly linked to childhood experience⁷².

An important American study used data from telephone interviews with over 2,000 adults living in the most populated parts of the USA to explore linkage between their environmental attitudes and behaviour and childhood experience. Adult behaviours measured included voting patterns, recycling, participating in practical programmes and preference for the outdoors.⁷³

The authors found childhood participation (before age 11) in "wild" nature such as hiking or playing in the woods, camping, and hunting or fishing, as well as participation with "domesticated" nature such as picking flowers or produce, planting trees or seeds, and caring for plants in childhood had a positive relationship to adult environmental attitudes. "Wild nature" participation was also positively associated with environmental behaviours while "domesticated nature" experiences are only marginally so.

However, they also found participation in environmental education programs (in school, in scouts, at camp, or in community environmental improvement programs) was **not** a significant predictor of either environmental attitudes or behaviours. The authors felt the adults interviewed may have experienced old fashioned highly structured childhood participation in environmental education rather than more engaging hands-on experience. Nevertheless, the study showed how important the quality of experience seems to be, with challenging, often solitary engagement in "wild" nature being particularly effective in generating environmentally aware adults. The paper concluded by quoting Chipenuik who wrote

"If in fact children do much of their learning about biodiversity and about the effects people have on biodiversity by making use of natural resources, then societies

*pursuing the goal of sustainability might do better to encourage childhood foraging*⁷⁴

Finally, it appears that there is even a long term financial benefit in childhood environmental experience and learning. Natural England found that Learning in the Natural Environment's value through its contribution to greater lifetime earnings associated with educational qualifications were (in 2010) to be £2.1 billion, £1.6 billion for GCSE subjects and £0.5 billion for A-Level⁷⁵.

6. Barriers to outdoor education

If outdoor education is so good, why isn't it yet happening for all children, everywhere?

Kings College London⁷⁶ identified barriers at sectoral (agency and ngo) levels and at schools.

- The challenges facing the Natural Environment sector include a lack of a coordinated effective approach to working with schools at a local level.
- The barriers facing schools include perception of the risk of accidents, cost and curriculum pressures. However, another set of challenges exists, at local, institutional and personal levels. These challenges include teachers' confidence, self-efficacy and their access to training in using natural environments close to the school and further afield.

It's important to add parental fears and misconceptions to the list to embrace home experience as well as schools.

Stephen Moss's excellent paper "Natural Childhood" highlighted many – and debunked some common concerns over safety

6.1 Parental concern over of traffic accidents

Deaths of children on roads has declined hugely, from 700 in 1976 to 81 in 2009, but this is not due to better traffic management, but because children are not allowed out of doors. Fear of cars is excluding children from local exploration. In 1971, 80% of 7-8 year olds took themselves to school, now only 9% do so alone. This should not be happening. In 2004 the charity Barnado's argued that our urban roads must be made safer⁷⁷ *so that children can play on them as their parents and grandparents did*. Nothing has since changed.

6.2 Perception that risks are all outside the home

Probably because parents feel (more or less) in control at home, they come to assume the risks to their children start when they go out of doors. In reality overwhelmingly most accidents occur within the home. Moss noted that one million children up to 14 are taken to

A&E departments with household chemical poisoning or burns. Half a million are injured, often by falling downstairs.

Natural environments are certainly not risk free, but allowing children to experience them gives kids the ability to learn risks and risk management. As Fiona Danks and Jo Schofield wrote:

“Life is full of risk, so the best way to prepare children for life is to ensure they know how to judge risk for themselves.”⁷⁸

Shielding children from rather imaginary risks stunts their ability to judge risk for themselves. The Health and Safety Executive is particularly scathing about the misuse of "H&S" by 'pedants' as an excuse to ban normal activities like conkers, and urged us to let children experiences 'sensible' risks⁷⁹.

6.3 Stranger danger.

The horrendous but fortunately very rare cases of harm to children by strangers now attracts so much press coverage that parents perceive it to be an everyday occurrence and strictly limit their offspring's autonomy out of doors. In reality, the overwhelming danger is from people within the extended family circle. The vast majority of sexual abuse is carried out by relatives of the victim: parents or step-parents, uncles or 'family friends', and when strangers are involved in "grooming", children are almost always exposed through social media contact within their home. In 89% of child murders, the victim is less than a year old, and attacked in their home by a relative.

With these statistics, it is clearly illogical to defend parental paranoia about the threat of outdoor strangers, but it could be that the propensity to distrust people we don't know is hard-wired from our evolution.

6.4 Over-cautious authorities

Over-cautious attitudes by teachers, police and others can result in them banning what they perceive as risky activities. Partly this is out of (misplaced) concern, partly no doubt for fear of retribution should something go wrong. Half of all children have been stopped from climbing trees and 20% banned from playing conkers or the so very basic game of tag. Other cases involve children reprimanded, warned or evicted for picking flowers, feeding ducks in a park, or building a den.

6.5 “Don't-touch” conservationists.

In the aim of protecting biodiversity, conservationists sometimes show a very precious attitude to nature reserves. Children are told to stand back, not to pick up or collect what they see and **definitely** not to pick any flowers. While they might cause a minute amount of very temporary damage, proper interaction with nature is key to their understanding and respect

for nature, which they will carry into their adult life. Moss also warns that the best outdoor experience is spontaneous, and confining all outside activity into worthy supervised learning experiences makes nature seem artificial and less real, and gives the impression the outdoors is only about guided tours, professional binoculars and learning objectives.

6.6 Special case of teenagers.

It's becoming a perception that while pre-pubescent children are controllable and sweet, and adults are self-disciplined (or should be), teenagers are unpredictable, feral, irresponsible and somewhat malevolent changelings that need special control. In reality, they need room for adventure and to test themselves as much as any group of younger children. Catherine Ward Thompson and her colleagues documented a number of barriers which restricted British teenager's access to "wild adventure space"⁸⁰

Young people from different groups and backgrounds do not have equal access to outdoor space. Public attitudes that view loose young people as an urban threat have helped marginalise them, a problem reinforced by one of the Home Office indicators for assessing neighbourhood safety, which classifies young people hanging around on the streets as anti-social behaviour. The barriers were grouped as below:

- a) Social exclusion
 - under-representation of young people from lower income households, disabled people, ethnic minority young people and teenage girls in outdoor experiences;
 - public attitudes towards young people as a problem and „threat“.
- b) Concerns about risk
 - educators“ and managers“ fear of litigation;
 - fears and concerns of parents and adults in positions of responsibility;
 - young people“s fears about safety, especially fears about other people/groups;
 - the need to impose rules and regulations on young people undertaking risky activities.
- c) Lack of adequate resources
 - lack of staff resources, in terms of numbers and expertise, in managing risk assessment and in working with young people;
 - poor quality of available spaces for young people;
 - lack of appropriate management and maintenance skills for wild adventure space on the part of local authorities;
 - a lack of attractive wild adventure spaces accessible by foot;
 - difficulties in transportation provision and costs to access adventure space further afield.
- d) Societal pressures
 - negative perceptions of woodland and wilderness fed by a range of media;
 - the attractions to young people of staying inside for amusement and comfort;
 - commercialisation of youth spaces;
 - the changing nature of childhood;
 - distrust and aggression from local residents about activities with young people;

- the need to work swiftly to deliver projects before young people mature;
- fears and scepticism from young people themselves.

The young people themselves saw the following as barriers

- the threat of Anti-Social Behaviour Orders (ASBOs);
- fear of other teenage groups and gangs;
- access to transport and costs of getting to distant sites;
- parents' concerns;
- lack of planning, wayfinding and organisational skills on the part of the young people themselves;
- bad weather, rain and cold in particular.

7. Conclusions

It's not the intention of this long and tedious document to come to a specific conclusion, but it could be summarised as:

- Modern children are pathologically isolated from nature and freedom to explore.
- There's plenty of hard evidence, and masses of more subjective evidence, that exposure to uncontrolled semi-natural or "wild" environments benefits all children physically, mentally and in terms of learning and socialisation.
- Children's experience of nature when young beneficially influences their attitude to nature, sustainability and the environment when they become adult, and it can even help them live longer healthier lives.
- There are major barriers stopping most children from experiencing nature in the ways that would give them benefit. Some of these are due to lack of human or financial resources, but the biggest and most insidious barriers are in terms of our misinterpretation of risk.

8. References

¹ https://en.wikipedia.org/wiki/Biophilia_hypothesis

² Schlebusch CM, Malmström H, Günther T, Sjödin P, Coutinho A, Edlund H, Munters AR, Vicente M, Steyn M, Soodyall H, Lombard M, Jakobsson M (2017) Southern African ancient genomes estimate modern human divergence to 350,000 to 260,000 years ago. <http://science.sciencemag.org/content/early/2017/09/27/science.aao6266>

³ Heerwagen, J. and Orians, G. 2002. The Ecological World of Children". Pp 29-63 in Children and Nature, Psychological, Sociocultural and Evolutionary Investigations. Kahn, P.H and Kellert, S.R eds MIT Press Cambridge

⁴ https://en.wikipedia.org/wiki/Jericho#Stone_Age:_Tell_es-Sultan_and_its_spring

-
- ⁵ George Modelski, *World Cities: –3000 to 2000*, Washington DC: FAROS 2000, 2003. ISBN 0-9676230-1-4.
- ⁶ Adli, M. 2011 LSECities <https://lsecities.net/media/objects/articles/urban-stress-and-mental-health/en-gb/>
- ⁷ M.D. Hunter, S.B. Eickhoff, R.J. Pheasant, M.J. Douglas, G.R. Watts, T.F.D. Farrow, D. Hyland, J. Kang, I.D. Wilkinson, K.V. Horoshenkov, P.W.R. Woodruff (2010) The state of tranquility: Subjective perception is shaped by contextual modulation of auditory connectivity. *NeuroImage* **53**:611-618 <https://doi.org/10.1016/j.neuroimage.2010.06.053>
- ⁸ Peen J, Schoevers RA, Beekman AT, Dekker J. 2010 The current status of urban–rural differences in psychiatric disorders *Acta Psychiatr. Scand.* **121**: 84–93
- ⁹ Sundquist, K., Frank, G., & Sundquist, J. (2004). Urbanisation and incidence of psychosis and depression: Follow-up study of 4.4 million women and men in Sweden. *British Journal of Psychiatry*, *184*(4), 293-298. doi:10.1192/bjp.184.4.293⁹
- ¹⁰ Bird (2007) Chapter 4 in *Natural Thinking: investigating the links between the natural environment, biodiversity and mental health*. RSPB Sandy, Bedfordshire http://ww2.rspb.org.uk/images/naturalthinking_tcm9-161856.pdf.
- ¹¹ United Nations, Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*.
- ¹² Pyle, R. (2003) ‘Nature Matrix: reconnecting people and nature’. *Oryx* 37(2): 206–214.
- ¹³ Louv, R. 2010. *Last Child in the Woods: Saving Our Children from Nature-deficit Disorder*. Atlantic Books
- ¹⁴ *Childhood & Nature: A survey on changing relationships with nature across generations* http://www.naturalengland.org.uk/Images/Childhood%20and%20Nature%20Survey_tcm6-10515.pdf
- ¹⁵ *Social Trends*, eds. Carol Summerfield & Penny Babb 2004, No 34 p187. HMSO
- ¹⁶ <https://www.nationaltrust.org.uk/documents/read-our-natural-childhood-report.pdf>
- ¹⁷ Toppo, Greg , (2010) http://usatoday30.usatoday.com/tech/news/2010-01-20-1Avideokids20_ST_N.htm?obref=obnetwork
- ¹⁸ Louv, R. (2011) ‘A timely truth’, in *National Trust Magazine* pp34-37
- ¹⁹ Prevot, Anne-Caroline & Julliard, Romain & Clayton, Susan. (2014). Historical evidence for nature disconnection in a 70-year time series of Disney animated films. *Public understanding of science* (Bristol, England). 24. 10.1177/0963662513519042.
- ²⁰ Thomas and Thompson (2004) *A Child’s Place: why environment matters to children*. London: Green Alliance/DEMOS.

-
- ²¹ Orr (2002) Political Economy and the Ecology of Childhood. In Kahn and Kellert (eds) Children and Nature: psychological, sociocultural, and evolutionary investigations. Cambridge, Massachusetts: The MIT Press: 279–303.
- ²² Balmford A, Clegg L, Coulson T and Taylor J; (2002) Why conservationists should heed Pokemon. *Science* 295 (5564) 2367b.
- ²³ Bebbington , Anne (2010) The ability of A-level students to name plants, *Journal of Biological Education*, 39:2, 63-67, DOI: [10.1080/00219266.2005.9655963](https://doi.org/10.1080/00219266.2005.9655963)
- ²⁴ Corbyn, Zoe (2008) Taxonomy is classified as discipline in critical decline. *Times Higher Education* 21/8/2008
- ²⁵ Thomas and Thompson (2004) *A Child's Place: why environment matters to children*. London: Green Alliance/DEMOS
- ²⁶ Thomas and Thompson (2004) *A Child's Place: why environment matters to children*. London: Green Alliance/DEMOS
- ²⁷ Pretty, J. et al (2009) *Nature, Childhood, Health and Life Pathways*. Interdisciplinary Centre for Environment and Society Occasional Paper 2009-02: University of Essex
<http://www.seed.co.uk/sites/default/files/resources/Nature%20Childhood%20and%20Health%20iCES%20Occ%20Paper%202009-2%20FINAL.pdf>
- ²⁸ Mygind E (2007) 'A comparison between children's physical activity levels at school and learning in an outdoor environment.' *Journal of Adventure Education and Outdoor Learning* 7 (2) pp. 161-176
- ²⁹ Fjortoft I (2004) 'Landscape as Playscape: The Effects of Natural Environments on Children's Play and Motor Development.' *Children, Youth and Environments* 14 (2) pp.21-44;
- ³⁰ Scholz U. and Krombholz H. (2007) Untersuchung zur körperlichen Leistungsfähigkeit von Kindern aus Waldkindergärten und Regelkindergärten. *Motorik* 1: pp.17-22.
- ³¹ Titman, W. (1994). *Special Places, Special People: The Hidden Curriculum of School Grounds*. UK: World Wide Fund For Nature/ Learning through Landscapes
<https://files.eric.ed.gov/fulltext/ED430384.pdf>
- ³² Thomas and Thompson (2004) *A Child's Place: why environment matters to children*. London: Green Alliance/DEMOS
- ³³ Kirby, M. (1989). Nature as a refuge in children's environments. *Children's Environments Quarterly* 6:1-12
- ³⁴ <https://www.gov.uk/government/publications/childhood-obesity-a-plan-for-action/childhood-obesity-a-plan-for-action#fn:2>
- ³⁵ Health and Social Care Information Centre (2015) Health Survey for England 2014

-
- ³⁶ UK Government Statistical Service 2017. Statistics on Obesity, Physical Activity and Diet England: 2017
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/613532/obes-phys-acti-diet-eng-2017-rep.pdf
- ³⁷ Johnson W, Li L, Kuh D, Hardy R (2015) How Has the Age-Related Process of Overweight or Obesity Development Changed over Time? Coordinated Analyses of Individual Participant Data from Five United Kingdom Birth Cohorts. *PLoS Med* 12(5)
- ³⁸ Yvonne Kelly, Alice Goisis, and Amanda Sacker (2015) Why are poorer children at higher risk of obesity and overweight? A UK cohort study. *The European Journal of Public Health*
- ³⁹ Start Active, Stay Active: A report on physical activity from the four home countries' chief medical officers, July 2011.
- ⁴⁰ <https://www.gov.uk/government/publications/childhood-obesity-a-plan-for-action/childhood-obesity-a-plan-for-action#fn:2>
- ⁴¹ Bell JF, Wilson JS, Liu GC. Neighborhood Greenness and 2-Year Changes in Body Mass Index of Children and Youth. *American journal of preventive medicine*. 2008;35(6):547-553.
doi:10.1016/j.amepre.2008.07.006.
- ⁴² Bird (2004) Natural Fit: can green space and biodiversity increase levels of physical activity? RSPB Sandy, Bedfordshire:
http://ww2.rspb.org.uk/Images/natural_fit_full_version_tcm9-133055.pdf
- ⁴³ Bird (2007) Natural Thinking: investigating the links between the natural environment, biodiversity and mental health. RSPB Sandy, Bedfordshire http://ww2.rspb.org.uk/images/naturalthinking_tcm9-161856.pdf.
- ⁴⁴ Wells NM and Evans GW (2003) Nearby Nature; A Buffer of life stress among Rural Children. *Environment and Behaviour*, vol 35, No3 311-330.
- ⁴⁵ Roe, J. and Aspinall, P. 2011, The restorative outcomes of forest school and conventional school in young people with good and poor behaviour. *Urban Forestry & Urban Greening* (2011),
doi:10.1016/j.ufug.2011.03.003
- ⁴⁶ Bird (2007) Natural Thinking: investigating the links between the natural environment, biodiversity and mental health. RSPB Sandy, Bedfordshire http://ww2.rspb.org.uk/images/naturalthinking_tcm9-161856.pdf.
- ⁴⁷ Faber Taylor, A. and Kuo, F.E 2009 Children With Attention Deficits Concentrate Better After Walk in the Park *Journal of Attention Disorders* **12**: 402 - 409
- ⁴⁸ Kuo FE and Faber TA (2004) A potential Natural Treatment for Attention-Deficit Hyperactivity disorder: Evidence from a national study. *American J Public Health* **94**:9 1580-1586.
- ⁴⁹ Herrington S and Studtmann K (1998) Landscape Interventions New Directions for the Design of Children's Outdoor Play Environments: *Landscape and Urban Planning* 42(2-4): 191-205.
- ⁵⁰ Lambert, E.B. (1999). "Do School Playgrounds Trigger Playground Bullying?" *Canadian Children* 24(1): 25-31.

-
- ⁵¹ Bento, G. and Dias, Gisela 2017. The importance of outdoor play for young children's healthy development. *Porto Biomedical Journal*, 2: 157-160 ISSN 2444-8664, <https://doi.org/10.1016/j.pbj.2017.03.003>
- ⁵² Ward Thompson, C., Travlou, P., & Roe, J. (2006). Free-range teenagers: the role of wild adventure space in young people's lives. Final report prepared for Natural England. Edinburgh: OPENspace. <http://publications.naturalengland.org.uk/file/71032>
- ⁵³ Liqing Zhang, Puay Yok Tan, and Jessica A. Diehl 2017. A conceptual framework for studying urban green spaces effects on health. *Journal of Urban Ecology*, 2017, 1–13 doi: 10.1093/jue/jux015
- ⁵⁴ Bird (2004) Natural Fit: can green space and biodiversity increase levels of physical activity? RSPB Sandy, Bedfordshire: http://ww2.rspb.org.uk/Images/natural_fit_full_version_tcm9-133055.pdf
- ⁵⁵ Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters*, 3(4), 390–394. <http://doi.org/10.1098/rsbl.2007.0149>
- ⁵⁶ Thwaites, K., Helleur, E. and Simkins, I.M. (2005) Restorative urban open space: Exploring the spatial configuration of human emotional fulfilment in urban open space. *Landscape Research*, 30:525-547. <https://doi.org/10.1080/01426390500273346>
- ⁵⁷ The National Environmental Education and Training Foundation Washington, DC (2000). *Environment – based Education: Creating High Performance Schools and Students.*
- ⁵⁸ Michelle Francesca Simone 2002. *Back to the basics : student achievement and schoolyard naturalization.* M.A. thesis Trent University 2002
- ⁵⁹ Thomas and Thompson (2004) *A Child's Place: why environment matters to children.* London: Green Alliance/DEMOS
- ⁶⁰ Dillon J. Morris M. et al (2005) *Engaging and Learning with the Outdoors: the final report of the outdoor classroom in a rural context action research project.* Slough: National Foundation for Educational Research
- ⁶¹ Rickinson, R., Dillon, J., Teamey, K., Morris, M., Young Choi, M., Sanders, D. and Benefield, P. (2004) *A Review of Research on Outdoor Learning* National Foundation for Educational Research. Field Studies Council: OP87, ISBN 1 85153 893 3
- ⁶² James, M. and Pollard, A. (2008) *Learning and Teaching in Primary Schools: insights from TLRP (Primary Review Research Survey 2/4),* Cambridge: University of Cambridge Faculty of Education. ISBN 978-1-906478-30-8.
- ⁶³ Christoph Randler, Angelika Ilg & Janina Kern (2005) Cognitive and Emotional Evaluation of an Amphibian Conservation Program for Elementary School Students, *The Journal of Environmental Education*, 37:1, 43-52, DOI: 10.3200/JOEE.37.1.43-52

-
- ⁶⁴ Coskie, T., Hornof, M. & Trudel, H. (2007), A natural integration. Quoted from “Understanding the diverse benefits of learning in natural environments” Kings College London April 2011 available at <http://publications.naturalengland.org.uk/file/5389125523865600>
- ⁶⁵ Miller D.L. 2007 The Seeds of Learning: Young Children Develop Important Skills Through Their Gardening Activities at a Midwestern Early Education Program. *Applied Environmental Education and Communication*, **6**:49–66
- ⁶⁶ RHS 2010 Gardening in Schools: A Vital Tool in Children's Learning. Royal Horticultural Society 15pp
- ⁶⁷ Morris J, & Zidenberg-Cherr S 2002 ‘Garden enhanced nutrition education curriculum improves fourth-grade school children’s knowledge of nutrition and preferences for some vegetables.’ *Journal of American Dietetic Association* 102 (1) pp. 91-93
- ⁶⁸ Block K.L. et al 2012. Growing Community: The Impact of the Stephanie Alexander Kitchen Garden Program on the Social and Learning Environment in Primary Schools. *Health Education & Behavior* **39**:419–432
- ⁶⁹ Christian MS, Evans CE, Nykjaer C, Hancock N, Cade JE. Evaluation of the impact of a school gardening intervention on children’s fruit and vegetable intake: a randomised controlled trial. *The International Journal of Behavioral Nutrition and Physical Activity*. 2014;11:99. doi:10.1186/s12966-014-0099-7.
- ⁷⁰ Hinds J. and Sparks P. 2011 The Affective Quality of Human-Natural Environment Relationships. *Evolutionary Psychology* (3) <https://doi.org/10.1177/147470491100900314>
- ⁷¹ Pretty J, Angus C, Bain M, Barton J, Gladwell V, Hine R, Pilgrim S, Sandercock S and Sellens M. 2009. Nature, Childhood, Health and Life Pathways. Interdisciplinary Centre for Environment and Society Occasional Paper 2009-02. University of Essex, UK.
- ⁷² Ward Thompson C., Aspinall P. and Montarzino A. 2007 The Childhood Factor: Adult Visits to Green Places and the Significance of Childhood Experience *Environment and Behavior* Vol 40, pp. 111 – 143 <https://doi.org/10.1177/0013916507300119>.
- ⁷³ Wells, Nancy M. and Kristi S. Lekies. (2006). “Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism.” *Children, Youth and Environments* 16(1): 1-24.
- ⁷⁴ Chipeniuk, R. (1995). “Childhood Foraging as a Means of Acquiring Competent Human Cognition about Biodiversity.” *Environment and Behavior* 27(4): 490-512.
- ⁷⁵ Natural England 2012 Learning in the Natural Environment: Review of social and economic benefits and barriers,. <http://publications.naturalengland.org.uk/file/1322812>
- ⁷⁶ Kings College London 2010 Beyond barriers to learning outside the classroom in natural environments <http://publications.naturalengland.org.uk/file/6621187224371200>
- ⁷⁷ Transport 2000 / Barnardo’s (2004) Stop, look and listen: children talk about traffic. www.barnardos.org.uk/traffic.pdf

⁷⁸ Danks, F. and Schofield, J. (2006) Nature's Playground. Frances Lincoln, London

⁷⁹ Health and Safety Executive (2006) press release: Get a life.
www.hse.gov.uk/press/2006/c06021.htm

⁸⁰ Ward Thompson, C., Travlou, P., & Roe, J. (2006). Free-range teenagers: the role of wild adventure space in young people's lives. Final report prepared for Natural England. Edinburgh: OPENspace.
<http://publications.naturalengland.org.uk/file/71032>