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Journal of Biological Education

ISSN: 0021-9266 (Print) 2157-6009 (Online) Journal homepage: www.tandfonline.com/journals/rjbe20

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To cite this article: Sophie Rich-Degeneve & Michael J. Reiss (23 Dec 2025): Nature benefits for teenagers, Journal of Biological Education, DOI: 10.1080/00219266.2025.2605035

To link to this article: https://doi.org/10.1080/00219266.2025.2605035

JOURNAL OF BIOLOGICAL EDUCATION
https://doi.org/10.1080/00219266.2025.2605035

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REVIEW ARTICLE

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Nature benefits for teenagers

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ABSTRACT

There is increasing concern that teenagers are spending less time in nature and more time on screens. We provide a narrative overview that looks at whether nature can help teenagers to be healthier and whether schools can assist by enabling greater access to green spaces for teenagers. We identified a total of three themes in the literature: 'Environmental and societal considerations', 'The mental health crisis' and 'Making nature accessible to teenagers'. Teenagers now have more sedentary lifestyles than they used to and are increasingly experiencing nature deficit. While much of the literature is correlational, making it difficult confidently to infer causation, it is clear that teenagers are increasingly suffering from a mental health crisis, and this may, at least in part, be the result of increasing screen use. Time spent in nature has clear benefits, including health benefits, for teenagers and there is much that schools can do to facilitate access to nature.

ARTICLE HISTORY
Received 16 June 2025
Accepted 20 November 2025

KEYWORDS
Nature benefits; teenagers; mental health; screen time; nature connection

Introduction

The two of us have had lifelong interests in issues to do with the natural environment and with young people. Sophie has a professional background in family law and is currently studying for a PhD in nature connection; she also has a teenage son. Michael converted from physics to biology 2 weeks into his undergraduate degree in 1975 and has remained in biology and education ever since. After a PhD and post-doc in evolutionary biology and behavioural ecology, he qualified as a secondary biology teacher and subsequently taught in the school sector and in initial teacher education. He has written widely about ecology and about biology education and is a trustee of a number of charities to do with science education or the welfare of young people.

We begin this Introduction thus because our interests are directly relevant to the focus of this article. Furthermore, each of us, in common with many others, has increasingly become aware over the past decade or so of the links between the natural environment and young people's welfare. In this article, we therefore look at whether nature can

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/00219266.2025.2605035.

nurture teenagers to be healthier and whether schools can assist by enabling greater access to green spaces for teenagers.

Our focus is on teenagers because, while the availability of outdoor environments for younger children that benefit their health and well-being has received considerable attention in research, policy and planning (Chawla 2015; Clark et al. 2020; Wells, Jimenez, and Mårtensson 2018), the same cannot be said for adolescents (Akpinar 2021). Indeed, there are many data suggesting that interest in nature tends to wane during the teenage years (Keith et al. 2022); however, teenagers do express positive feelings about being in nature (Zamora et al. 2021). This ambivalence may be a consequence of living in an increasingly technological world where the lure of bright lights and screens is hypnotically appealing to many. However, we may be living at the very time when connections to nature should be encouraged, particularly given that the incidence of poor mental health continues to rise amongst adolescents and time spent in nature is associated (as we discuss below in more detail) with improved mental health in young people (Zamora et al. 2021). Nevertheless, we acknowledge that this is a field where much of the data is correlational and where the evidence for causation is less robust than is desirable. We therefore pose two research questions: 'Can nature help teenagers to be healthier?' and 'Can schools assist by enabling greater access to green spaces for teenagers?'.

Methodology

This article presents a review. There are many types of review; indeed, one highly cited article identifies 14 of them (Grant and Booth 2009). Possibly, the best known nowadays are systematic reviews. Indeed, more than 10,000 systematic reviews are published in the health sciences each year (Clarke and Chalmers 2018). First used in medicine, they then started to be used in the social sciences and other fields. Their great advantages are their rigour and high level of objectivity, and it is this that has made systematic reviews so central to the evidence-based medicine movement.

In education, however, there are several reasons to be less optimistic of what systematic reviews can achieve. The first is that the underlying reliable evidence base is often literally one or more orders of magnitude less than in medicine; the huge amount of money that pours into medical research utterly dwarfs the amount that goes into education research. The second is that the questions that education research seeks to answer are often more complicated. The third is that the principal method beloved of systematic reviews, namely random-controlled trials, are often less feasible in education. Suppose, for example, one wants to test the hypothesis that a new type of drug gives longer-lasting pain relief. It is feasible randomly to allocate patients to two groups, one that receives the standard medication and one that receives the new drug, with neither the patients nor the researchers knowing which patient has received which treatment (a so-called double-blind random-controlled trial). But suppose that one wants to test the hypothesis that inquiry-based science education leads to better learning outcomes than traditional teaching. One cannot arrange for a double-blind random-controlled trial, as the children know what they are getting, not to mention the teachers who are doing the teaching. Furthermore, the teachers mediating the treatment under investigation play a far greater role than those who administer the drugs intended to relieve pain. It is

perfectly possible that a teacher charged with delivering an inquiry-based approach may feel uncomfortable doing so and therefore teach less well than they usually do. Equally, it is perfectly possible (the problem of 'contamination') that a teacher charged with delivering the traditional approach may hear that the new approach (inquiry-based teaching) is leading to greater student engagement and so, possibly even subconsciously, starts using aspects of inquiry-based teaching in their own teaching.

None of this is intended to decry the value of systematic reviews in education. Indeed, one of us has undertaken several of them. It is simply to point out that, valuable as they are in education, they should not be regarded as the 'gold-standard', compared to which other types of review are made of baser metal. In the language of Grant and Booth (2009), we seek to provide an 'Overview' (p. 95). This provides a 'summary of the literature that attempts to survey the literature and describe its characteristics' (p. 95). An overview 'May or may not include comprehensive searching (depends whether systematic overview or not)' (p. 95), is 'Typically narrative' (p. 95) and 'may be chronological, conceptual, thematic, etc'. (p. 95). An overview is appropriate for this review as we seek to look at whether nature can help teenagers to be healthier and whether schools can assist by enabling greater access to green spaces for teenagers for two main reasons: first, because of the compound nature of our focus ('Can nature help teenagers to be healthier?' and 'Can schools assist by enabling greater access to green spaces for teenagers?'); secondly, because adopting the rather strict criteria of a systematic review would result in excluding a lot of literature that is germane to the focus (a common problem with systematic reviews in education).

We therefore present a non-systematic, narrative overview (Merga and Oddone 2025) with the findings organised thematically – by which is meant not a sort of 'thematic analysis' à la V. Braun and Clarke (2006) but that we have identified a number of major themes that help organise the literature in response to our focus: 'Environmental and societal considerations', 'The mental health crisis' and so on. The literature comes partly from that accessed by Sophie in the course of her PhD and partly from that with which Michael is familiar, supplemented by additional searches undertaken for the purposes of this review. Once again, we emphasise that this is not a systematic review. We began by using the University of Exeter library database and Google Scholar to search, using the following key terms: 'screen time', 'children' and 'nature'; 'nature connection' and 'young people'; 'benefits of nature connection'; 'nature deficit' and 'health'; 'green space' and 'young people'; 'nature' and 'young people'; 'benefits of nature'; 'outdoor learning'; 'digital education'; 'mental health crisis'; 'mental health' and 'teenagers'; 'mental health' and 'screens'; 'nature connection' and 'mental health'; 'mental health' and 'UK'; 'physical movement' and 'health'; 'health' and 'wellbeing' and 'nature'; 'education' and 'screens' and 'nature'; 'nature' and 'health'; 'green space' and 'education' and 'concentration' and 'learning outcomes'; 'imagination' and 'exercise' and 'outdoors' and 'nature'. Later in the writing process, Google Scholar was sometimes used to see if there were additional more recent articles on particular issues that emerged as this article was being drafted and to see if alternative points of view existed. Preference throughout was given to publications that were recent, peer-reviewed, authored by acknowledged leading researchers and were themselves reviews. The overwhelming majority of the publications we obtained were written in English and we acknowledge that we made no attempt to mitigate this bias, for instance by searching in different languages.

The literature is not always clear about the distinction between teenagers and adolescents and the terms are sometimes used interchangeably. A *teen*ager is clearly someone between the age of thir*teen* and nine*teen* (inclusive); adolescence is the time between childhood and adulthood, which clearly varies between cultures and at different periods in history. The World Health Organization (2025) defines an adolescent as any person between the ages of 10 to 19, though some divide adolescence into early (10–13), middle (14–17) and late (18–21) phases. Related terms include 'youth' and 'young people', both of which are understood by the United Nations to refer to individuals between the ages of 15 and 24, though the United Nations acknowledges that there is no universally agreed international definition (United Nations n.d.). A useful feature for us of 'teenagers' is that their age range corresponds fairly closely with the secondary phase of schooling in many countries (often 11–12 to 16–19).

Two final points. First, implicitly, we adopt a critical realist rather than a positivist, constructivist or other position (Bhaskar 1975). In other words, we hold that ontologically there is a single reality – but the problem comes in our attempts to gain knowledge of it. So, we maintain that spending more time in nature does have certain objective consequences for teenagers; the difficulty is in ascertaining these consequences and in determining the extent to which they vary among teenagers. Secondly, while we paid attention to the possibility that there might be disadvantages to teenagers being in nature (e.g. sunstroke, insect bites), such negative consequences are far less extensively identified in the literature than are the positive consequences that result from teenagers being in nature. Accordingly, we have titled this article 'Nature benefits for teenagers'.

The literature review

We identified a total of three themes. Two of these – 'Environmental and societal considerations' and 'The mental health crisis' – relate to our first research question ('Can nature help teenagers to be healthier?'); the third – 'Making nature accessible to teenagers' – relates to our second ('Can schools assist by enabling greater access to green spaces for teenagers?'). Much has been written about thematic analysis (e.g. V. Braun and Clarke 2021; Purssell and Gould 2021), where it is widely accepted that themes emerge from an interaction between researchers' backgrounds and interests and the data they are analysing. This point holds to an even greater extent when it comes to 'identifying' themes in a literature review. We do not claim that others undertaking this review, even if they had read the same publications as we did, would necessarily identify the same three themes. At the same time, our three themes emerged as we undertook the review – not in advance of it! Furthermore, our themes operate as structuring devices – they are not our findings (in the way that themes in a thematic analysis can be); they are our way of organising what we judge to be the key findings in the literature.

Environmental and societal considerations

Teenagers now have more sedentary lifestyles than they used to (e.g. Gula 2022), because of a whole range of factors (Martins et al. 2021). Cars are now much more widely available, so that teenagers are more likely to be driven to leisure activities that take place away from their home than in the past, when they were more likely

to walk or cycle. The widespread availability of home computers and smartphones means that teenagers are now much more able to keep in touch with their peers without leaving their homes than when face-to-face communication was the norm. It is also the case that many parents are more worried, than used to be the case, about the consequences of their children spending unsupervised time away from home (Loebach et al. 2021). Such factors have led to a nature deficit in children and young people (Dong and Geng 2023). In just one generation, the lives of many children have transitioned to being largely indoors (Chawla 2022). A 2022 study in England found that 74% of children spent less time outdoors than did prison inmates (Clybiau Plant Cymru Kids' Clubs 2024). Another study undertaken in 2022, in the UK, found that 27% of children said they regularly played outside their homes, compared to 71% of the baby boomer generation (born between 1946 and 1964) (Save the Children 2022).

As we discuss in our second theme below, nature deficit has been identified as a risk for well-being and mental health, since being in nature can provide opportunities for coping (Dong and Geng 2023) and reduce feelings of stress (Ewert and Chang 2018). Being in nature also involves being physically active, and physical activity, aside from its physical health benefits (van Sluijs et al. 2021), can help protect against poorer mental health in children and adolescents. More sedentary behaviour has been found to correlate with increased psychological depression and lower psychological well-being in children and adolescents (Rodriguez-Ayllon et al. 2019). A World Health Organization analysis of data from 298 school-based surveys from 146 countries, territories and areas that included 1.6 million students found that 81% of 11–17 year-olds were insufficiently physically active: 78% of boys and 85% of girls (Guthold et al. 2020). Physical activity also falls sharply between ages 11 to 15 in most EU countries for both genders. Some of the factors influencing the levels of physical activity undertaken by children include their studies and other competing pastimes, in particular screen activities. It has been found that heavy use of mobile devices and the internet takes time away from other activities, including physical activity (OECD Health Policy Studies 2019).

Youth in some studies expressed the desire to spend more time in nature but many were unable, due to barriers such as demanding schedules, mostly due to academic and social pressures (Zamora et al. 2021). Internationally, it has been observed that an increase in children's screen usage corresponds with reductions in the time children spend in natural environments (Torjinski and Horwood 2023), while the social and psychological benefits of time in nature are inversely correlated with screen-related child health outcomes (Oswald et al. 2020).

There are various explanations for the relationship between screen time or technology use and children's physical and mental health. Excessive screen time or technology use can adversely affect children's physical health both through a reduction in physical activity and through alterations in sleep patterns (Fomby et al. 2021). Time is certainly a factor to be considered, as is interest. Teenagers are probably exposed to greater demands on their time than are younger children, given that they are more independent and can engage in activities that were not open to them when they were younger. However, it is also the case that young people are spending more time online than they used to (Dong and Geng 2023; George et al. 2023; Paulich et al. 2021), which reduces the time available for them to be outdoors.

Macur (2021) argues that teenagers need help to recognise the harmful effects of modern digital technologies and that too much time spent online diminishes performance at school. However, it is pertinent to consider how realistic it is to expect teenagers to spend less time online, given that they are growing up in a highly digitalised world that steers all age groups towards techno dependence (Vanderloo et al. 2022), and where many adults are themselves 'addicted' to screens (Goksen and Ince 2024). Screen technology has been identified as being harmful to children and the evidence that it helps school students to learn is not that clear (McFarlane 2019; Reiss 2021). An OECD report found that the impact of computers on pupil performance was 'mixed, at best' (OECD 2015, 3). In another review, Baker, Tricarico, and Bielli (2019) found that examples of educational technology that succeeded in achieving impact at scale and making a desired difference to school systems as a whole (beyond the particular context of a small number of schools) were rarer than might be supposed. There is a case for calling for unbiased and honest discussion with young people and educators regarding the consequences of technological dependence, particularly since, according to some academics, excessive screen time has reached epidemic proportions among young people (George et al. 2023).

Given the social, economic and other pressures on all of us, including teenagers, to use digital technologies, it is incredibly difficult to avoid them, perhaps especially when one is a teenager when peer pressure is intense (Giletta et al. 2021). Schools increasingly use screens; teenagers use screens outside of school (at home, on the move); thus, the exposure of teenagers to screens is typically high. At the same time, screen use too often has negative impacts on mental health. Almost every parent of a teenager will profess to having had concerns at some point about screens, and yet schools increasingly use screens in the classroom, though many schools do not permit students to use their smartphones during school hours (Böttger and Zierer 2024; Rahali, Kidron, and Livingstone 2024). It is salutary to note that even back in 2013, Public Health England found that extended screen use was linked to anxiety, depression and distress in children (Public Health England 2013). For some 20 years, the American College of Paediatricians has warned that excessive screen time is associated with sleep problems, obesity, increased aggression and low self-esteem. Their current guidelines recommend:

- Children under the 6-18 months should have no screen time except for video chats with family and friends. For children 18–24 months, media use should be limited, and you should always have a caregiver or parent participating with the child.
- Children ages 2–5 should have no more than an hour of screen time a day with care taken to provide only educational, high-quality programs. Preschoolers especially need parents to be available to explain the things they are watching that may not make sense.
- From ages 5–18, parents should set consistent limits on the amount of screen time. In general, it is recommended to not be more than 1–2 hours a day. Whenever media use takes away from health, family time, and sleep habits it should be lessened (American College of Pediatricians 2019).

We are a long way from this being the reality. Excessive screen time is described by some as an epidemic among young people (George et al. 2023). Technology does not

evolve of its own accord; hardware and software are promoted by those with a commercial interest in selling them. The global EdTech market size was valued at USD123 billion in 2022 and it has been claimed that it could reach USD605 billion by 2027 (Stratton 2024). At the same time, we fully acknowledge that recent research is increasingly indicating that digital technologies have great potential to help students' learning. Fundamentally, this is because they can offer re-time, personalised feedback in a way that is all but impossible for even the most gifted of teachers faced with typical class sizes (Kestin et al. 2025). Nevertheless, the picture is still a mixed one with some recent studies finding no benefits (e.g. Hall and Lundin 2024).

When considering some of the pressures on their time that school children face, we might look to find solutions to the problem of the lack of time that they spend in nature, given what is practicable, taking into consideration the hours taken up with study and extra-curricular commitments. For instance, would schools be willing to provide their students with 1 hour per day, or even just per week, of time outside? This could be time outside in the school grounds, or in a local park, if available. Students might observe nature, discuss ideas, engage in breathing exercises or meditation, take gentle exercise and undertake other wellbeing activities to balance the intensity of the school day with its grade requirements, attendance code and indoor-orientated teaching. Schools possess an invaluable opportunity to provide at least some redress in response to the rising problem of mental health issues. This would help reconnect students with nature, not only for students' own health benefits but also for the future health of the natural world, since contact with nature is known to promote care for nature (Richardson et al. 2020). Between 2010 and 2020, persistent hopelessness, sadness, and suicidal thoughts and behaviours all increased by about 40% among young people in the USA (American Psychological Association 2023). As the psychologist Professor Kimberly Hoagwood put it: 'We're seeing really high rates of suicide and depression, and this has been going on for a while' (American Psychological Association 2023).

One way to address this problem is by changing school policies to provide more support for all students. For example, school connectedness, the degree to which young people feel that adults and peers at school care about them and are invested in their success, is a key contributor to mental health. Youth who felt connected during secondary and high school have been found to have fewer problems with substance use, mental health, suicidality and risky sexual behaviour as adults (Steiner et al. 2019). The idea of schools incorporating regular, ideally daily, sessions of non-formal outdoor 'learning', with the goal of providing opportunities to share and learn wellbeing approaches with peers and teachers is something that is not too difficult to organise but could be quite radical. It is an idea that would be likely to be beneficial not only for individual students but also for the whole school because, as we have already discussed, behaviours and even grades have been seen to improve when children get out into nature. Outdoor learning in nature is clearly an enriching experience for children (and teachers), enabling them to learn (and teach) beyond the confines of their classroom. This type of outdoor learning has the potential to directly and indirectly strengthen a school's educational practice (Blair 2009; Goodall 2016; Rickinson et al. 2004; Wistoft 2013).

There is a large literature concerned with the benefits of outdoor and informal learning, so much so that it seems inappropriate for those whose primary concern is school education to ignore it. According to Jucker and von Au (2022), outdoor learning

'enables cumulative, fundamental fostering of learning in multiple dimensions, such as academic learning, social interaction, personal development and well-being, mental, physical and social health, creativity, and much more. It is an add-in approach, easy to integrate into normal schooling, at very low cost. It therefore should be very high up on the agenda of any decision maker who is concerned with the future of our education systems' (p. 12). Being in nature can promote an increase in positive feelings (Ballew and Omoto 2018), aid concentration (Jimenez et al. 2021), aid better bone health (Sleurs et al. 2024) and promote stronger immune systems (Andersen, Corazon, and Stigsdotter 2021).

The mental health crisis

There is currently an international mental health crisis (Benton, Boyd, and Njoroge 2021), particularly amongst teenagers (Patalay and Gage 2019). Indeed, some researchers say that adolescents are experiencing unparalleled levels of mental health issues and stress. However, this age group is understudied in terms of which green environments are restorative for them (Akpinar 2021). Mental health problems are likely to continue into adulthood if not addressed during childhood/adolescence. According to Abrams (2022), on nearly every metric, post-school student mental health is worsening. During the 2020–21 college year, more than 60% of college students in the US met the criteria for at least one mental health problem (Lipson et al. 2022). In the latest survey for which data are available in the US, 21% of undergraduate respondents were assessed as experiencing serious psychological stress (American College Health Association 2024).

In the UK, NHS data has exposed what Members of Parliament and health leaders have called a 'devastating explosion' of mental illness, with the number of children referred to emergency mental healthcare in England having increased by more than 50% in the 3 years to 2022–23 (Gregory 2024). In 2022 alone, a record 1.4 million children and young people in England sought NHS help for mental health issues (Campbell 2023). In children in England aged 7–16, in 2017, 12.1% had a probable mental disorder; by 2022, that figure had increased to 18.0% (NHS England 2022).

Many scholars have found that as social media and technology use rise, so do mental health issues. Research indicates that students' general happiness and life satisfaction decline with more screen time. In one study of 8th and 10th graders, for example, researchers found that students associated non-screen activity with greater happiness, and screen activity with less happiness (Twenge, Martin, and Campbell 2018). In another study, Twenge et al. (2018) found a significant increase in depressive symptoms and suicidal thoughts in adolescents in the 2010's in the US, particularly noting that this increase correlated with smartphone ownership and social media use. Furthermore, using nationally representative samples, they found that 'adolescents low in in-person social interaction and high in social media use reported the highest levels of depressive symptoms' (p. 9), indicating that as use of social media increased, so too did mental health issues.

Since the increase in the use of screens is impacting a huge swathe of people, the problem is somewhat obfuscated and normalised. Some studies have found that even if young adults are not 'addicted' to their 'phones, use can still lead to impaired social functioning, worse sleep quality, and intolerant boredom (Greenfield 2018; Pantic 2014;

Scott, Biello, and Woods 2021). Young adults may be of an age when they have the autonomy to decide such things as 'phone/screen use for themselves; however, for children there is a need for relevant adults to acknowledge the depth of the problem and take meaningful steps to alleviate it. According to Xu, Tedrick, and Gold (2023), there is a burgeoning body of literature that identifies a high prevalence of mental health conditions in people who have high levels of screen time exposure. In 2024, Dr Elaine Lockhart, Chair of the Royal College of Psychiatrists' Child and Adolescent Faculty, said, 'it's unacceptable that so many children and young people are reaching crisis point before they are able to access care. We cannot allow this to become the new norm' (Royal College of Psychiatrists 2024). It is important that teenagers get help quickly which is why it is imperative that schools acknowledge and address the reality of child mental health. Dr Lockhart adds "the evidence shows us that children who receive support quickly are less likely to develop long-term conditions that negatively affect their education, social development and health in later life (Royal College of Psychiatrists 2024).

At the same time, it is important to emphasise that not all experts are convinced that the rise in 'phone/screen use is responsible for the rise in mental health issues among teenagers, nor that reducing 'phone/screen use would have the desired benefits. A recent consensus statement on the potential negative impacts of smartphone and social media use on adolescent mental health, undertaken by 150 experts, found that 99% of them agreed that 'There is evidence that adolescent mental health has declined over the last two decades in the USA' (Capraro et al. 2025, 13). However, fully 94% also agreed that 'The available evidence is too limited and inconsistent to draw conclusions about the claim that phone-free schools would benefit the mental health of adolescents overall' (p. 17). Similarly, a recent systematic review concluded: "We found suggestive but limited evidence that greater use of MP/WD [mobile 'phones or other wireless devices] may be associated with poorer mental health in children and adolescents" (Girela-Serrano et al. 2024, 1621).

Whilst there is much talk surrounding the crisis in young people's mental health, there is less discussion of solutions, yet it is crucial that solutions are sought, particularly given the size of the crisis and to prevent long-term conditions from developing. Changing the way we do education now, by incorporating time in nature, well-being activities and working with children differently, could radically change the future of these young people for the better. Some scholars call for a shift towards a more holistic approach to education, including cultivating social and emotional development in parallel with the focus on academic achievement. By including a focus on wellbeing and developing a sense of community, schools can positively impact the mental health and overall flourishing of students and educators, creating thriving communities (Frazier and Doyle Fosco 2024).

Contact with nature has been shown to help alleviate feelings of depression or low self-esteem in teenagers. It has been found that being outside in natural settings can have a positive impact on overall well-being, even in times of crisis (Jackson et al. 2021). The reduction in exposure to nature has deprived young people of the sorts of positive experiences that help promote their mental health. Within the last 20 years we have seen a huge increase in the use of digital technologies. Clearly, the time young people spend looking at electronic screens displaces time that they could spend engaging in outdoor activities. One US study (Vizcaino et al. 2020) assessed adults' screen time across

multiple devices (including TV, video game consoles, laptops/computers, smartphones, and tablets). Total screen time for light, moderate and heavy users had medians of 7, 11.3, and 17.5 h per day, respectively. Heavy users reported the least healthful dietary patterns and the poorest health-related characteristics, including frequency of fast-food consumption and perceived stress.

One way of alleviating the obstacle that electronic screen technology may pose to connecting with and being in nature would simply be to provide opportunities for individuals to disconnect for meaningful periods of time (Michaelson et al. 2020). It has been argued that a symptom of increased exposure to screens is feelings of stress, with adolescents recently reporting greater levels of stress (Hartley, Prideaux, and Vaughn 2023). Being in nature is increasingly prescribed for improving mental health in adolescence (Lee, Kim, and Ha 2019; Vanaken and Danckaerts 2018). Nature is generally understood as organisms, landscapes and other features and products of the Earth, and is contrasted with human-made features of the environment, i.e. artificial, built environments (cf. Hartley, Prideaux, and Vaughn 2023).

Exposure to greenery among an urban adolescent population is associated with decreased psychological stress (Mennis, Mason, and Ambrus 2018); similarly, increased greenness around the homes of adolescents is associated with decreased serious psychological distress (Wang et al. 2019). Exposure to nature contributes to a general reduction in the physiological symptoms of stress (Berto 2014). One study found beneficial longitudinal relationships between exposure to nature and reduction of psychosocial indicators of stress in adolescence (Van Aart et al. 2018), while worse mental health in adults has been linked to low nature connection in childhood (Preuß et al. 2019). Adolescents can use nature to relieve their stress, and nature can be used to support teenagers' mental health. As natural landscapes are often cleared for new infrastructure, it is important to protect and, where possible, extend natural habitats (cf. Berman 2025). This is especially needed in urban areas where nature is already more limited (Hartley, Prideaux, and Vaughn 2023).

Time spent in natural settings makes a positive contribution to youth development and competence (Bowers, Larson, and Parry 2021). Indeed, urban young people experience a stronger sense of self and a wider view of the world when in nature (Birch, Rishbeth, and Payne 2020) as well as a stronger sense of connection with nature. A sense of spiritual fulfilment amongst young adults spending time in nature has been identified in some studies (Snell and Simmonds 2015). Nature has also been found to have a calming effect, whereby sensory experiences become prioritised over worries about personal stress (Puhakka and Hakokõngäs 2023). Indeed, the more time that teenagers spend in nature, the more they recognise the benefits of doing so, with positive consequences for their wellbeing (Rantala and Puhakka 2020), ultimately forging new neural pathways and managing stress better. Nature can therefore be seen as providing a 'toolkit' for managing stressful aspects of life.

Making nature accessible to teenagers

Teenagers typically express positive feelings towards nature, saying that it has an uplifting effect on their mood (Hakokõngäs and Puhakka 2023), but they do not get outside in nature as much as they used to (Hakokõngäs and Puhakka 2023; Larson et al. 2019; Louv

2005; Zamora et al. 2021), and, as we have reviewed above, this can have negative consequences for their health. The question to be asked then is, given the benefits of getting outside in nature, how can teenagers be encouraged (enabled) back out into the 'wild'? One way forward would be to bring nature closer to teenagers via the availability and accessibility of green spaces closer to where they live or go to school. Some scholars have long argued that nature is harder for teenagers to access than was the case for previous generations and that they may face exclusion from public outdoor spaces due to a societal ambivalence towards them (Hart 1987). As a result, adolescents find it harder to access outdoor spaces (Brunelle et al. 2018). Indeed, it has been argued that urban policy and design that limits teenagers' access to local public spaces and natural environments undermines children's right to their movements and impedes the creation of child- and teen-friendly cities as outlined by the Child Friendly City Initiative, a manifestation of the Convention on the Rights of the Child (United Nations Children's Fund 2014).

The health benefits of nature are understood to occur through three principal mechanisms: restorative capacity via relaxation and mental reinvigoration; building capacities via physical activity and being in social settings; and reducing harm via improvements to the environment, such as removing air pollutants (Markevych et al. 2017). Zamora et al. (2021) noted that the youth in their study reported that being in nature relieved or reduced stress and anxiety and helped them feel at peace and calm. These findings aligned with previous research among European youth, which found that nature provides relief and calm for youth (Birch, Rishbeth, and Payne 2020). As discussed above, it has been noted that as young people grow older, they spend less time in nature and correspondingly more time indoors (Hughes et al. 2019). There appears to be an association among youth between increased exposure to and uptake of technology and electronic media across the world and a decline in nature-based outdoor time (Kellert et al. 2017). Teenagers are not taken to parks in the same way that young children are, and are less welcome in playgrounds (Barron 2022). It is important to acknowledge such age-related attitudes and behaviours, if ways of enabling adolescents to spend more time in nature are to be found. One solution would be for schools to lead the initiative and provide more green spaces for teenagers. For example, schools with existing green spaces could teach some lessons outside. Schools with less green space could take steps to create more such space; indeed, teenagers could be engaged in this process, not only giving them a sense of responsibility and purpose but also giving them an opportunity to be autonomous, creative and productive.

One way of providing young people with accessible opportunities to access nature settings would therefore be if schools would incorporate more greenery into their playgrounds/outdoor areas. There is clearly a lot that schools can potentially do to facilitate their students having access to nature within the school grounds. Schools are clearly well placed to provide these opportunities since children spend so much of their day at school. These simple and easily realisable actions have been shown to have positive outcomes for children, both in terms of academic improvement and wellbeing. Teenagers who get out into natural green environments show lower levels of stress and mental fatigue compared to those teenagers who spent time indoors (Greenwood and Gatersleben 2016). Simply seeing trees though classroom windows can have a positive impact on concentration and academic study (Kuo and Jordan 2019). School playgrounds with greenery have been found to be more restorative, in

that they reduce stressful feelings and increase feelings of clarity compared to playgrounds without greenery (Akpinar 2016; Bagot, Allen, and Toukhsati 2015). However, teenagers are generally less welcome in playgrounds than are small children (Simonetti 2000) and there is limited provision of space for them. Given that children living near parks with playgrounds have been found to have better mental health than children living in areas without these provisions (Acolin et al. 2022), and the more general finding that contact with nature produces a calmer state of mind and positive changes in mood (Puhakka and Hakokõngäs 2023), schools could reframe the conventional model of passive classroom learning and incorporate more active and dynamic approaches to learning by taking lessons outdoors, and by recognising the benefits of natural settings to learning and well-being in students. Schools should also give serious consideration, as many are, to the accumulative impact of student screen use in the classroom coupled with screen use at home (Böttger and Zierer 2024).

Encouragingly, there are a whole raft of initiatives, in many countries, to facilitate teenagers spending more time in nature (e.g. T. Braun and Dierkes 2017; Gelmez Burakgazi and Reiss 2024; Harris 2021; Laffitte, Seyler, and Tang 2022). Positive experiences in nature tend to foster an enduring connection to nature as well as generating feelings of well-being. Thus, the idea of schools being active participants in providing nature connection possibilities, given the multitude of benefits for teenagers, is quite an exciting one.

Discussion

In this review, we have examined the evidence that more time spent in nature would benefit teenagers. It is important to acknowledge that many studies that conclude that large amounts of screen time are associated with poor health outcomes, or that more time spent in nature is beneficial, rely on correlations – this is an area in which it is obviously difficult to have intervention studies, so the literature largely relies on 'natural' experiments. However, while it is widely accepted that correlation doesn't *necessarily* imply causation, it often does, though research in the medical field does 'provide evidence of causal assertion overreach drawn from correlational findings' (Hung, Bounsanga, and Voss 2017, 902).

With this caveat in mind, we have shown in this narrative overview that in response to our two overarching research questions – 'Can nature help teenagers to be healthier?' and 'Can schools assist by enabling greater access to green spaces for teenagers?' - three principal themes can be identified in the literature: 'Environmental and societal considerations', 'The mental health crisis' and 'Making nature accessible to teenagers'. Here, we summarise the key findings from the literature under each theme, evaluate where the evidence is strong or weak, and indicate what the implications are for secondary schools.

Environmental and societal considerations

There is strong evidence that teenagers now spend less time outdoors than in previous generations. This typically results in poorer physical and mental health. There is some evidence that teenagers would like to spend more time outdoors; one reason why they

don't is the very large amount of time they typically spend on screen, particularly on their smartphones.

The mental health crisis

Although long-term longitudinal data are sparse and diagnostic criteria can change over time, the evidence is quite strong that the current generation of teenagers has poorer mental health than their parents' and grandparents' generations did when they were teenagers. The evidence is also quite strong that very high levels of time spent by teenagers on screen is not good for their mental health. However, it is important not to overstate the evidence that average amounts of time regularly spent on screen is bad for teenagers' mental health. There has been a long history of 'moral panics' arising from changes in the behaviours of teenagers, which often, a couple of decades later, do not seem as deeply worrying as initially supposed. Examples include child abduction, the use of illicit drugs and the consequences of media violence (Critcher 2008).

Making nature accessible to teenagers

Acknowledging, once again, the reality that most studies can only impute rather than conclusively demonstrate causality, the evidence is strong that the benefits for teenagers of spending more time out-of-doors are considerable. This is what has led, for example, to the Forest School movement. Interestingly, this movement mainly targets pre-teenagers (e.g. Cudworth and Lumber 2021; Sella et al. 2023), yet its benefits extend to teenagers (e.g. Manner, Doi, and Laird 2021).

There is much that can be done out of schools to enable teenagers to spend more time in nature – for example, there is a role for town planning (Antiri et al. 2025; Wood 2020). However, our particular interest is on what secondary schools can do. There would seem to be two main possibilities. For one thing, schools can improve the quality of the environment of their grounds, by providing more green spaces and facilitating access to them, so that teenagers choose to spend more time in nature. For another, schools can require students to spend more time in nature, whether for particular school subjects (notably, biology and geography but others too) or for non-subject reasons.

Our overall conclusion from this review is that there are considerable benefits, particularly health ones, for teenagers in spending more time in nature. Schools are well positioned to help facilitate this – an argument which, we suspect, will be both familiar and attractive to many readers of *Journal of Biological Education*.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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