

# Environmental education through STEM

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**Abstract** This article explores how STEM subjects can enable students to learn about the key environmental issues that we face, using the National Association for Environmental Education's recent teacher handbooks about 'The Environmental Curriculum' and details of the Sustainable Development Goals to help do this through a mix of input and small-group discussion.

## Background

NAEE is a UK charity that began life in 1960 as the Rural Studies Association and became the National Association for Environmental Education in 1970. NAEE's purpose is to promote all forms of environmental education, and to support all those involved in its delivery, so that, together, we can understand and act on the need to live more sustainably in order to protect the future of our planet.

The Association does this in a number of ways, including:

- publishing a journal – *Environmental Education*. This was first published in 1971 and is aimed at practitioners and policymakers. It is published three times a year, carries reports on environmental education in schools and the community, and offers insights into the Association's work with schools and NGOs. It is free to members. Typically, the journal contains feature articles on aspects of the curriculum, school reports, commentary on recent developments and book reviews.
- producing curriculum reports and reviews that offer analyses and commentary on contemporary issues. NAEE has published two recent handbooks (NAEE, 2017; 2018) looking at opportunities for environmental education in (a) the early years foundation and primary stages, and (b) key stages 3 and 4.
- giving bursaries to West Midlands schools to enable students to study in outdoor environmental education centres. The bursaries can be used to cover centre fees and transport costs and are possible because of the benevolence of the late Hugh Kenrick. In return, schools write a report that explores the environmental aspects of the visit and how it is linked to work in the school. Reports are published in the journal.

- providing a website (<http://naee.org.uk>) that is a window into the work of the Association and a source of environmental education ideas and activities. The following are regularly updated pages: feature articles about environmental education practice in schools; book reviews; webwatch posts about what like-minded organisations are doing; blogs with opinion and comment on environmental education policy and practice; *Twitter* and *Facebook* feeds; journal back numbers; and a dedicated members' page.

## Environmental education

It is a view widely held by those involved that environmental education should foster caring, responsible attitudes and inspire young people to take action in order to live more sustainably and develop a sense of identity and pride in the local environment and community. Importantly, it not only covers the natural world, but also the built environment, and the ways in which humans relate to the places where they live.

Following Arthur Lucas (1972), NAEE sees that environmental education can be classified into education *about* the environment, education *for* (the preservation of) the environment, education *in* the environment, and the combinations of these: *about* and *for*, *about* and *in*, and *for* and *in*.

Lucas saw the distinctions between these as follows:

- Education *about* the environment is concerned with providing cognitive understanding including the development of skills necessary to obtain this understanding.
- Education *for* the environment is directed environmental preservation, or preservation for particular purposes, characterised by their aims.
- Education *in* the environment is characterised by a technique of instruction.

He added that *in* the environment can mean the world outside the classroom, as well as the biophysical and/or social context in which people live.

Lucas was writing at a time when many of the environmental problems we now face were already apparent, although an exception to this was the significance of carbon dioxide emissions and the global warming that has ensued since industrial development began. Forty-five years on, the problems we face are both much clearer and much more urgent, and there is wider recognition of them. For example, the report (UNESCO, 2015) of the World Conference at the end of the UN Decade for Education for Sustainable Development (DESD) in Aichi-Nagoya, Japan, in November 2014, placed a lot of stress on the need for environmental education. In this context, the Crown Prince of Japan said:

*On our Earth today, along with economic growth and increasing populations, we are also witnessing the advancing change of climate, loss of biodiversity, depletion of natural resources, increases in poverty and other problems. For our children and theirs, we have three important tasks: protecting the Earth's environment, which is the wellspring for ensuring lives abundant with blessings, treasuring the Earth's limited resources, and achieving sustainable development.*

And Princess Lalla Hasna of Morocco said:

*To think and act for the sake of the environment – in the broadest sense of the term – means to be fully aware that the planet is not only a precious legacy, but that it also implies a tremendous responsibility for us in terms of preserving the interests of future generations.*

A focus on such issues has been at the heart of environmental education for many years, and 2017 saw the 40th anniversary of the United Nations' Tbilisi Declaration, which set out the importance of environmental education to the future of the planet, its people and the biosphere. NAAEE's 1976 statement of aims was a key part of the UK documentation presented at Tbilisi, and there was then a widely shared feeling that, as the Earth's problems became more acute, environmental education would be increasingly seen as more and more necessary. However, in those 40 years, it has not really been like that. For example, the blossoming of curriculum interest in the 15 years that began in the mid-1970s, which led to a range of A-level, GCE and CSE courses in environmental science and environmental studies in the UK, was brought to a shuddering halt by the conformity and centralisation of the National Curriculum. Although environmental education was granted cross-curriculum theme status, that didn't mean much in the end, especially in secondary schools where a subject curriculum and specialist, expert subject teachers tend to combine to militate against cross-curricular work.

That said, there are excellent examples of schools exploring ways of subject departments working together to address such issues, and also of adopting whole-school approaches to them. Despite much criticism of it, and for all its faults, the current National Curriculum does provide numerous opportunities for schools, teachers and students to explore a wide range of the world's most pressing issues.

There have also been significant changes in the wider world over recent years. The Paris Agreement to limit climate change was signed in December 2015 and the UN has demanded that countries work to realise the 17 Sustainable Development Goals (SDGs). Taken together, and if successful, these programmes will transform the lives of billions of people across the planet – including in the UK. The Paris Agreement and the SDGs not only embody the hope of a better world – socially, economically and environmentally – they also represent a race against time. In a narrow sense, this is a race faced by people who dice on a daily basis with preventable destitution, social exclusion, discrimination, malnutrition, illness and an early death. In a broader one, it's a race faced by us all, as we work to limit global warming and climate change before lasting damage is done to planetary systems. There are positive signs out there, but many negative ones as well. For example, the COP24 meeting in Poland in 2018 resulted in agreement on a rule book for putting the 2015 Paris Agreement into practice. However, although the agreement commits countries to keeping global warming well below 2°C compared with pre-industrial times, the voluntary pledges that countries have currently made will probably result in 3°C of warming.

Closer to home, in the first week of January 2018, the UK government launched its much anticipated 25-year plan to improve the environment. Although this sees a positive role for schools and for other community-based education providers, which will generate opportunities for environmental educators, it looks rather limited. As Dillon (2018) noted:

*The 25-year plan seems to miss a fundamental point... Schools and their leaders have a key role in influencing public attitudes and empowering students to support the reverse of decades of environmental degradation in both urban and rural areas, but this plan, for all its merits, only pays lip-service to a challenge that must be at the heart of social change in England and, indeed, all of the UK*

## The Sustainable Development Goals

As noted above, 2015 saw the Paris Agreement on climate change and the launch of the Sustainable Development Goals. The focus of the goals is transforming people's lives.

They follow on from the reasonably successful but less extensive Millennium Development Goals.

Figure 1 shows the icons that represent the 17 goals and Table 1 summarises the goals' purposes. These apply to everyone in the world and cover our most pressing issues – for example, poverty, hunger, equality, energy, clean water and sanitation, biodiversity, climate change, economic growth, sustainable cities, and responsible consumption, as well as strategies such as education and justice.

A number of the goals (indicated with an \* in Table 1) are of particular interest and relevance to science education.

Although economic growth, international aid and development-focused trade will play the main role in realising the goals, it is obvious that education will have

## SUSTAINABLE DEVELOPMENT GOALS



**Figure 1** Icons of the 17 Sustainable Development Goals

a key role, and a disproportionately important one, in economically developed countries such as the UK. Here, goal-related learning by students can help increase the likelihood that the goals will be valued, supported and

**Table 1** The 17 Sustainable Development Goals

No.	Key word summary	Goal statement
1	No poverty	End poverty in all its forms everywhere
2*	Zero hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3*	Good health & well-being for people	Ensure healthy lives and promote well-being for all at all ages
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Gender equality	Achieve gender equality and empower all women and girls
6*	Clean water & sanitation	Ensure availability and sustainable management of water and sanitation for all
7*	Affordable & clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Decent work & economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Industry, innovation & infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
10	Reducing inequalities	Reduce income inequality within and among countries
11	Sustainable cities & communities	Make cities and human settlements inclusive, safe, resilient and sustainable
12*	Responsible consumption & production	Ensure sustainable consumption and production patterns
13*	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
14*	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15*	Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16	Peace, justice & strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

UN agency websites have more detail of the goals and the 169 targets associated with them.

hence realised; and a critical study of the goals in schools can enhance the focus, and help raise the quality, of student learning.

There is a temptation to see school-age young people as merely preparing for further study, and yet they are already consumers and citizens who make ethical and other judgements on a daily basis, and who have beliefs and values. There is, therefore, a responsibility on those working with young people to ensure that they are helped to contribute to a more just and sustainable future. None of this is an argument for a study of the goals, per se, as some new curriculum area or subject. Rather, it's a case for seizing the opportunities that present themselves to focus on the goals during formal and informal education, both within institutions and in the community, working across ideas and disciplines where sensible; and with appropriate partners whenever possible. Every UK school now has an opportunity for its teaching and wider activities to cover a range of the goals, and working in partnership with community groups has the capability to bring teachers, students, leaders and external agencies together. Many such groups are already active in their own right, working with young people and others in community settings to help raise awareness and understanding of the goals and to bring about change. Hallam (2019) has presented an analysis of how the goals can be embedded in the curriculum.

The goals and their associated targets are obviously not perfect, and some feel they do not go far enough to address the root causes of our global problems. Others argue that the 17 goals are not equally important and that the world needs to prioritise those areas that will have the most impact. Both these points reinforce the need to help young people acquire the skills to think critically about the goals themselves and to understand how to influence and effect change locally, nationally and globally. The interests of science and environmental educators in all these are clear. But the goals also offer schools and NGOs a means of bridging the divide between environmental issues and social justice matters – across science and the humanities.

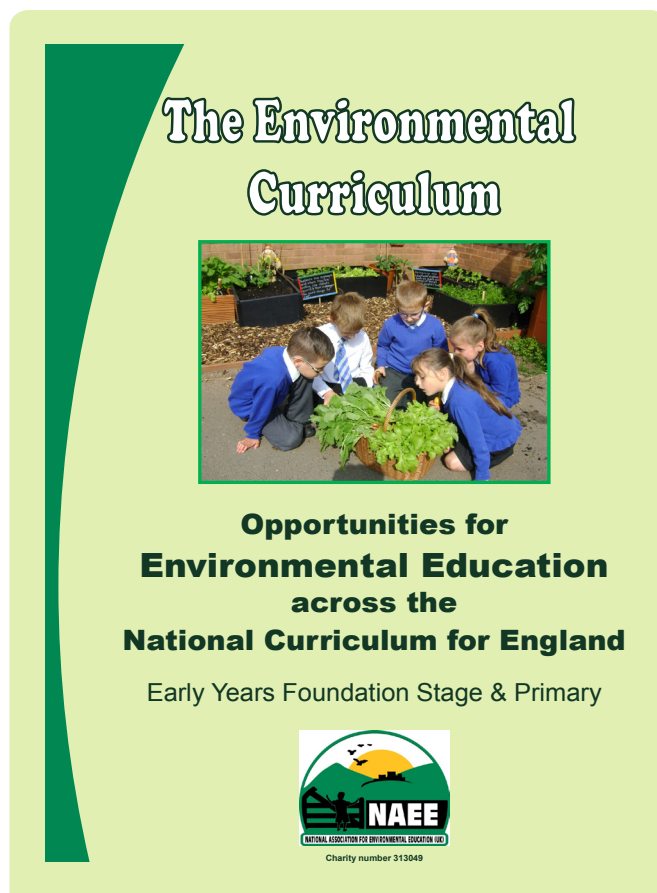
## Curriculum analysis

The two handbooks on 'The Environmental Curriculum' that NAEE has produced (NAEE, 2017; 2018) analyse what the National Curriculum says, and also exemplify how teachers are seizing opportunities to explore these issues with students. Each handbook contains case studies of practice that illustrate what's possible in schools today; these are of relevance to experienced practitioners, for whom there will be insights from other people's work, as well as to those just starting out, as a wide range of teaching and learning opportunities are carefully set out for scrutiny, evaluation and adaptation.

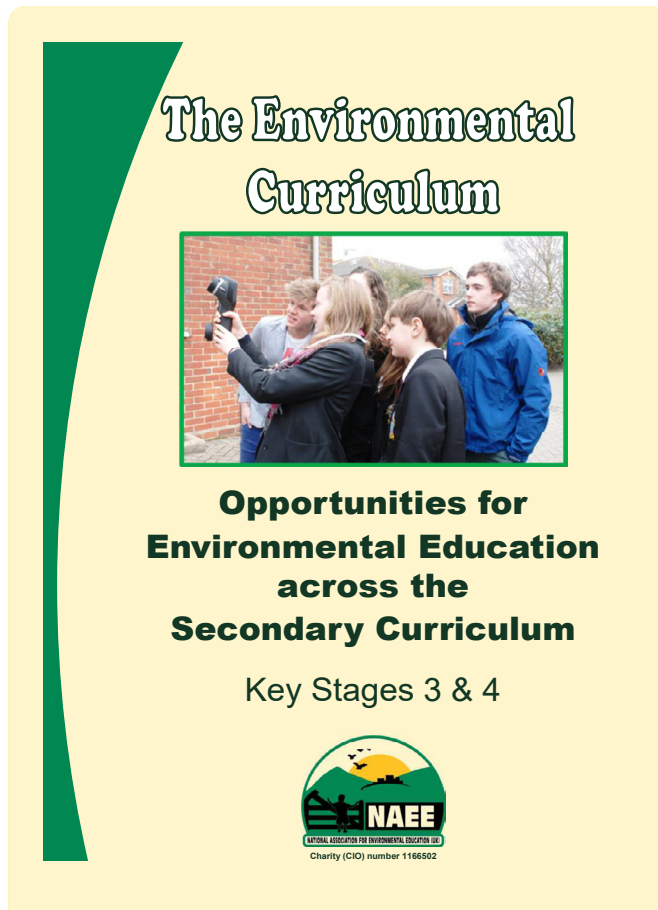
The strong focus on learning through play in the foundation stage makes it the ideal time for children to begin systematically exploring the built and natural environment in the world around them. This helps them develop a sense of place, an awareness of their world and a deeper understanding of the need to care for it. The early years section of the 2017 handbook shows that there is a good fit between the early years foundation stage framework (2014) and outdoor learning generally, and environmental education in particular. This applies across all three characteristics of effective learning (playing and exploring; active learning; creating and thinking critically) and also to the prime areas (personal, social and emotional development; physical development; communication and language) and specific areas (literacy; maths; understanding the world; expressive arts and design) of learning. The primary section of the handbook looks at environmental education opportunities within the whole curriculum across both key stages, including science, design and technology, and maths.

The secondary report (NAEE, 2018) has a strong focus on science with sections on 'working scientifically' in biology, chemistry and physics across both key stages. There are also sections on design and technology, geography and other aspects of the curriculum.

Historically, environmental education has mainly been experienced in schools through geography and science



**Figure 2** NAEE's 2017 early years and primary curriculum handbook



**Figure 3** NAEE's 2018 key stages 3 and 4 curriculum handbook

studies. Although there is considerable overlap between these when it comes to the environment, collaboration in secondary schools between subject specialist teachers has usually been problematic owing to different traditions and disciplinary practices. That said, as the curriculum analysis makes clear, the science curriculum is perfectly positioned to give students insights into the workings of the natural world and the difficulties caused for it by how we currently live. A high-quality science education provides the foundations for understanding the world and, through it, students can be encouraged to recognise the power of rational explanation and be supported in developing a sense of curiosity and excitement about natural phenomena.

The key stage 3 curriculum states that '*teachers should feel free to choose examples that serve a variety of purposes, from showing how scientific ideas have developed historically to reflecting modern developments in science*' and this maps well onto what environmental education offers. At key stage 4, there is an even better fit as this is extended to include '*informing students of the role of science in understanding the causes and solutions to some of the challenges facing society*'.

Given that school is a key means of introducing young people to the blessings and problems of the wider world, and in preparing them for life within it, it seems neglectful if schools do not take the manifold opportunities that the environmental curriculum offers to explore all these issues.

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## Useful online resources

The UN Development Programme has facts and figures for each of the goals along with a summary of the issues at stake, and mini case studies of the goals in action at: [www.undp.org/content/undp/en/home/sustainable-development-goals/](http://www.undp.org/content/undp/en/home/sustainable-development-goals/).

The UN's Sustainable Development Solutions Network website has details of the 169 targets associated with the goals at: [www.un.org/sustainabledevelopment/sustainable-development-goals/](http://www.un.org/sustainabledevelopment/sustainable-development-goals/).

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