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THE VALUE OF AN ENVIRONMENTAL SCIENCE EDUCATION

EDITORIAL

The value of an environmental science education

Environmental education is fundamental to achieving humanity's transformative challenge: 'Providing a decent life and wellbeing for nearly 10 billion people by 2050, without further compromising the ecological limits of our planet and its benefits'.[1] Some positive indicators of progress include the growth of the UK environment sector, mounting student focus on climate change and other sustainability issues, and an increase in the value of environmental education in the UK (from £61 million in 2010 to £251 million in 2018).[2] However, despite these, on current trajectories, we are unlikely to meet this transformative challenge.

The Decade of Action to deliver the Sustainable Development Goals by taking action to 'end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030' started this year.[3] As environmental scientists and environmental educators, we have a responsibility to increase the pace of this action. We need to drive forward changes that will prepare people for the environmental challenges they will face in their lifetimes, equip them to be resilient, adaptable, skilled and knowledgeable, and give them agency to build a better future as they confront a range of global environmental challenges related to a rapidly changing climate.

The breadth of environmental education, coupled with the interdisciplinary nature of environmental science, provides scope for our students to specialise in a range of disciplines in order to identify, understand and mitigate environmental challenges. Environmental science programmes empower students to confront these challenges by focusing on solutions, developing professional skills and embedding practice through authentic assessment. The knowledge, skills and attributes that are fostered through environmental science education are desperately needed to address global sustainability issues.

Environmental science also offers an interdisciplinary framework for students to explore global sustainability issues across traditional disciplinary boundaries, to learn to value different approaches and points of view, and to appreciate how different disciplines link together. Developing both subject-specific and interdisciplinary knowledge enables students to take a more holistic, systems-level approach to thinking about environmental challenges, and to address the complex issues that exist at the intersections between environment, society and economy.

We need environmental professionals who understand the interdependence of social–ecological systems and who can distil knowledge to society and facilitate interdisciplinary solutions. As advocates of a transition to a sustainable society underpinned by sound science, the IES and CHES (the Committee of Heads of Environmental Sciences) have an essential role to play in shaping and championing environmental science education that bridges the gap between scientists and other stakeholders in society. We must ensure approaches and solutions towards achieving humanity's transformative challenge are evidence-based and informed by science, and empower our members to do the same.

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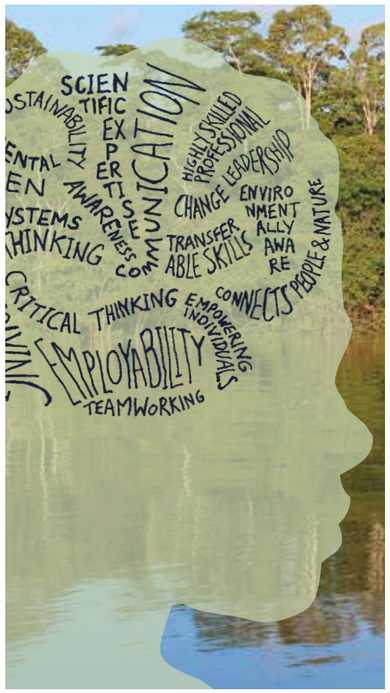

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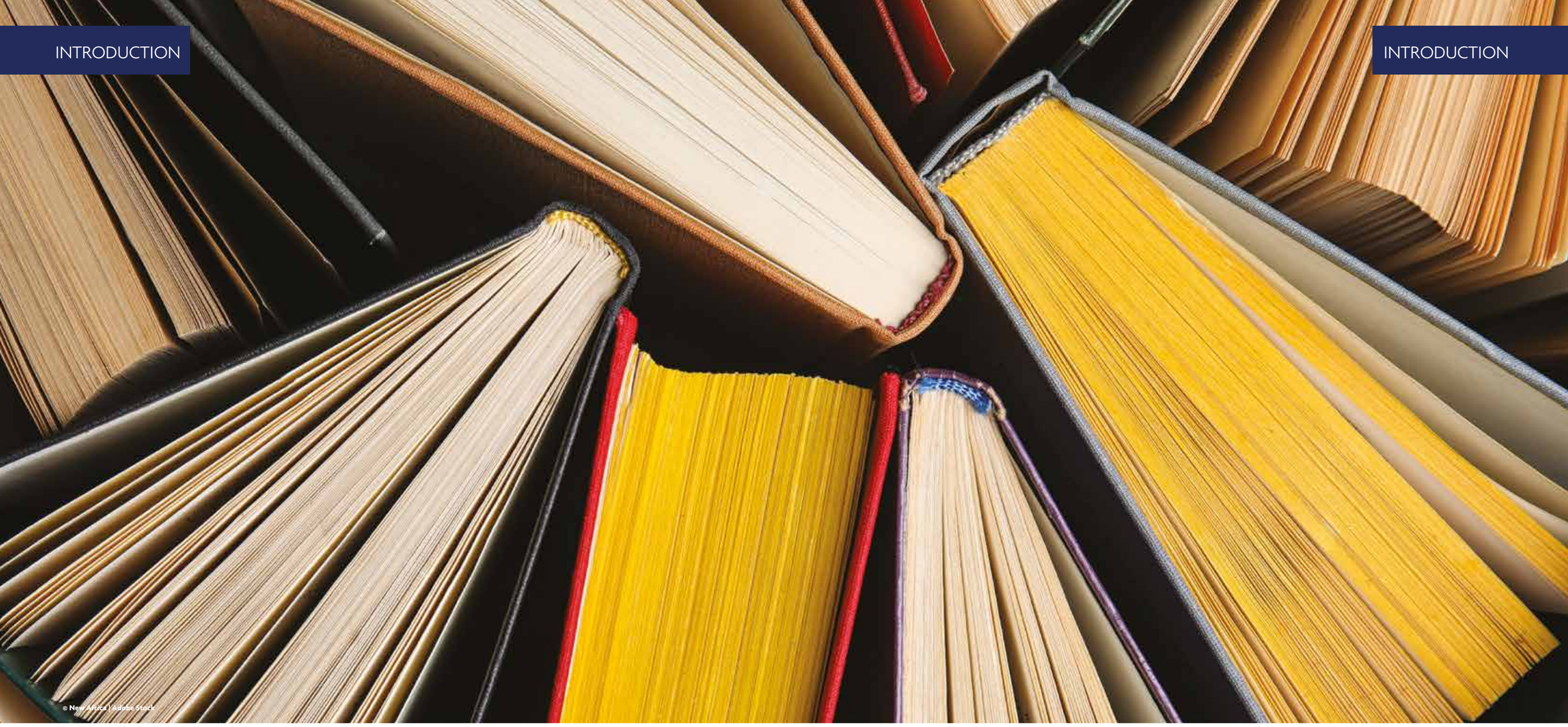
INTRODUCTION



More than just knowledge

Michelle Hale reviews the benefits of an environmental science education to individuals, societies and the planet.

In secondary, further and higher education, environmental science is a multidisciplinary subject focusing on the study of the environment and solutions to environmental problems. It incorporates the study of the physical, chemical and biological processes that take place on Earth, as well as the social, political and cultural processes that impact the planet. The discipline integrates a diverse range of subjects, including atmospheric science, chemistry, ecology, geography, geology, mineralogy, oceanology, physics, soil science, sustainability and zoology. The multidisciplinary nature of the field means that in UK higher education, environmental science encompasses a wide range of degree programmes – applied ecology; earth and ocean science; energy, environment and sustainability; environmental conservation; environmental geography; environmental hazards; environmental management; environmental toxicology and pollution; geographical information systems; and marine biology, amongst others.

However, in its broadest sense, environmental education is a process that allows individuals to connect to the world around them, learn about natural and built environments, explore environmental issues, engage in problem solving, and take action to improve and sustain the environment. Environmental education is more than simply learning information about the environment (see **Table 1**), and as a result, individuals gain a deeper understanding of environmental issues and develop the skills needed to make informed and responsible decisions. Environmental education does

▼ **Table 1. Environmental education is more than information about the environment[1]**

Environmental education	Environmental information
Increases awareness and knowledge of environmental issues	Provides facts or opinions about environmental issues
Teaches critical thinking	Does not necessarily teach critical thinking
Enhances individuals' problem-solving and decision-making skills	Does not necessarily enhance individuals' problem-solving and decision-making skills
Does not advocate a particular viewpoint	May advocate a particular viewpoint

not advocate a particular viewpoint or course of action but instead teaches individuals how to weigh various sides of an issue through critical thinking and enhances their own problem-solving and decision-making skills.[1]

The importance of environmental education was clearly articulated in 1978 during a UN-sponsored conference in Tbilisi, Georgia:

"Environmental education... should constitute a comprehensive lifelong education... it should prepare the individual for life through an understanding of the major problems of the contemporary world, and the provision of skills and attributes needed to play a productive role towards improving life and protecting the environment with due regard given to ethical values. By adopting a holistic approach, rooted in a broad interdisciplinary base, it recreates an overall perspective which acknowledges the fact that natural environment and manmade environment are profoundly interdependent."[2]

ENVIRONMENTAL EDUCATION AT SCHOOL

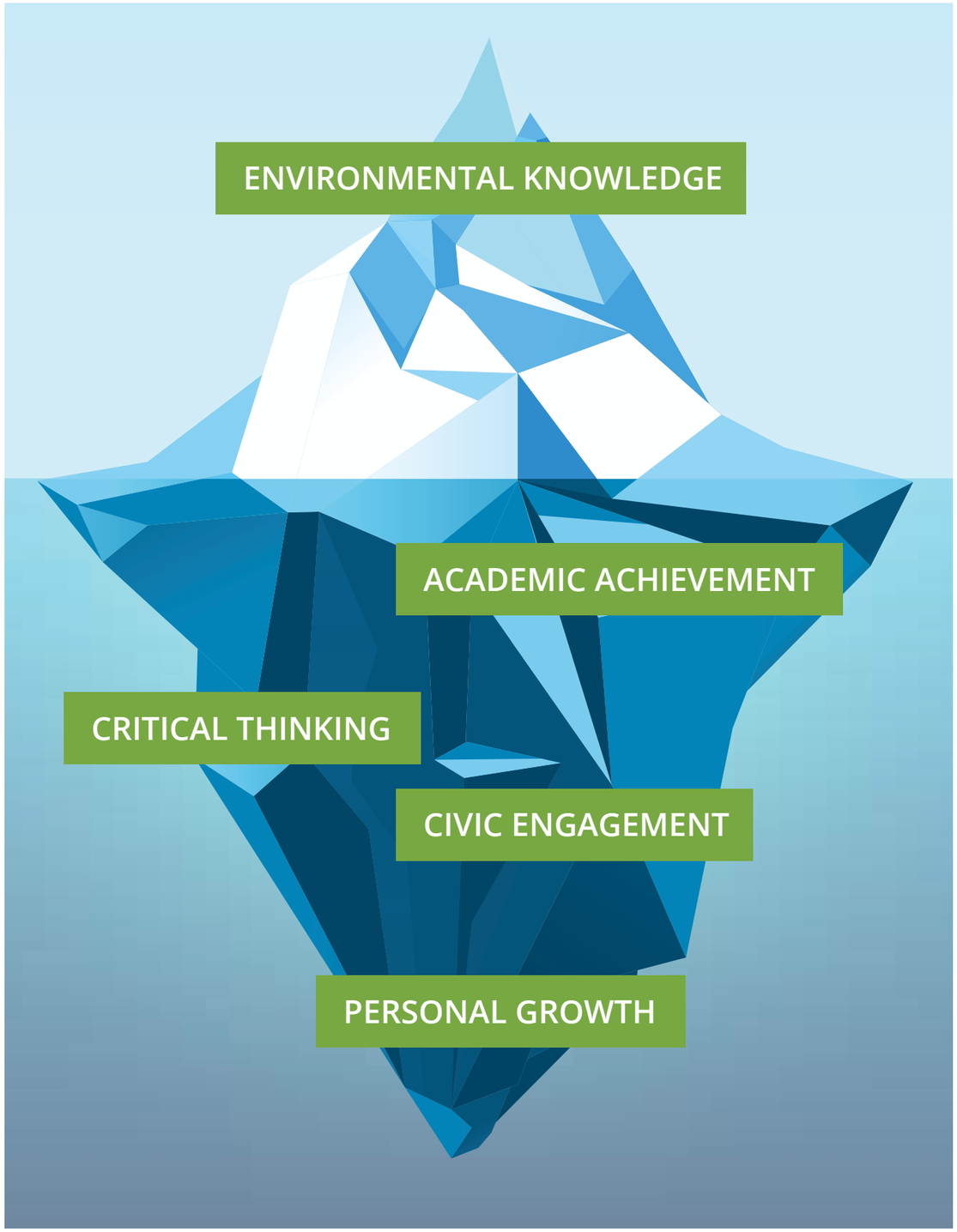
There is clear evidence that environmental education for nursery to A-level students provides a variety of benefits to students, teachers and the wider community. Students taking part in environmental education not only gain knowledge about the environment, develop an appreciation of the natural world, and enhance their physical wellbeing,[3] but also show other positive impacts, including improved academic performance, enhanced critical-thinking skills, personal growth and life-building skills (including confidence, autonomy and leadership), increased civic engagement and positive environmental behaviours[4] (see **Figures 1** and **2**). Of studies looking at the impact of environmental education on primary and secondary students, 98 per cent found that students gained knowledge, 90 per cent reported that students increased skills and 83 per cent reported that students exhibited enhanced environment-related behaviours.[4]

HIGHER EDUCATION

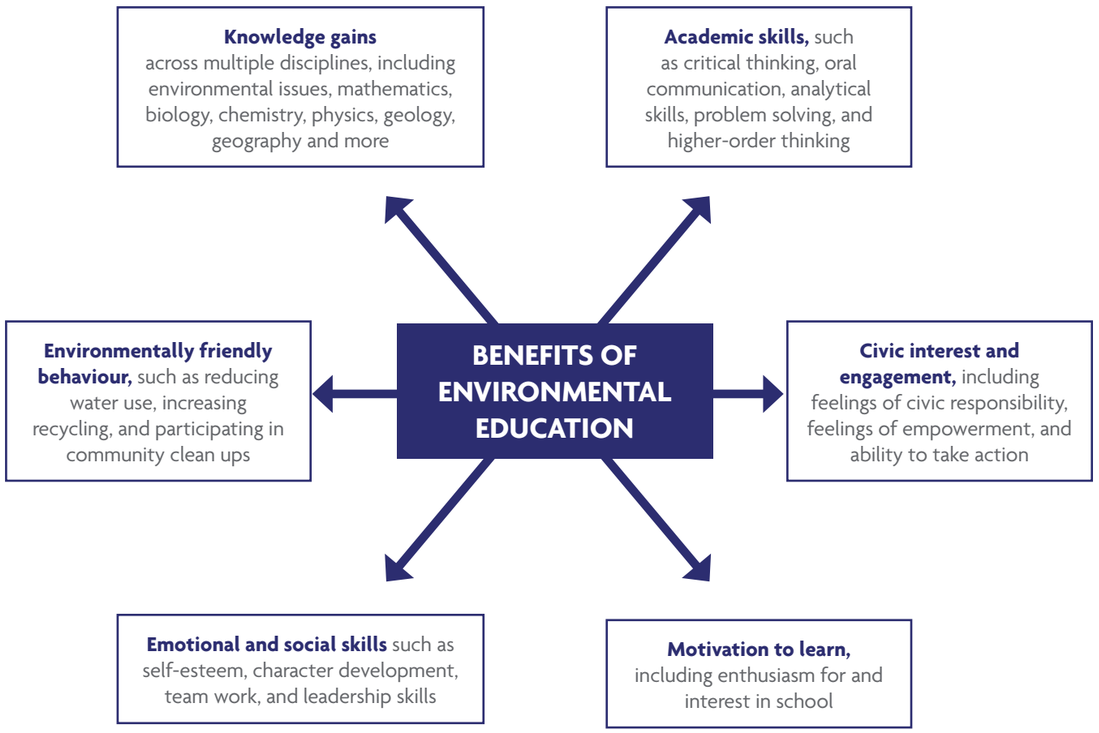
The true value of anything cannot be judged from its monetary cost alone, and value itself means different things to different people. Recently, there has been a great deal of public discussion about the value of university degrees. With students now paying fees of £9,250 a year in England and additional costs for accommodation and living expenses, it is understandable that anyone would consider employability and future earnings before deciding to enter higher education. However, in focusing so much on the economic benefits to individuals, the broader conversation risks missing the much wider value of an environmental science education.

Even on economic grounds, however, the value of an environmental science degree is clear. In 2019, a survey conducted by the IES found that the national average annual salary for an environmental scientist in the UK was £40,250 (range = £21,880–£76,670).[6] Importantly, 85 per cent of employees found their work meaningful and felt that they made a positive contribution to society or the environment.[6] Respondents also reported that they enjoyed the variety of work, the flexibility of their role and the challenge of the job. It is also clear that the environmental goods and services sector makes a substantial contribution to UK gross domestic product (about 1.6 per cent), providing £62.5 billion of output to the economy in 2015 and growing year on year.[7]

However the value of an environmental science education is much more than solely economic. For an individual aspiring to a career as an environmental scientist, there is clear value in undertaking an environmental science degree. In addition to the obvious benefits of the opportunity to foster and develop expertise in the discipline, the transition to higher education provides extensive personal development opportunities. As



▲ **Figure 1. Gaining environmental knowledge is the tip of the iceberg in terms of the benefits of an environmental education.[5] (© NAAEE, N.M. Ardoin, A.W. Bowers)**



▲ **Figure 2. The wider benefits of an environmental education.[5]**

students transition from secondary education into higher education, they experience numerous changes, including moving to a new city, a new educational system, changes to interpersonal relationships (forming new relationships with students, peers, university support and academic staff), and changes to existing relationships with family and school friends. The changes experienced through this transition provide individuals with an opportunity to develop strategies to overcome these challenges, leading to self-reliance and personal growth.

While such personal development is not unique to an environmental science degree, the multidisciplinary nature of the course means that students are encouraged to take a holistic, whole-world view. As a result, students undertaking an environmental science degree are more likely to widen and deepen their knowledge and understanding than a student embarking on a single discipline degree.[8] Furthermore, the emphasis on real-world learning and assessments means that individuals are given the opportunity to develop key personal and professional skills that are highly sought after by employers.

LIFELONG ENVIRONMENTAL LEARNING

The importance of education to address current global sustainability challenges has been widely recognised. There is a need for environmental knowledge to permeate into larger society and its decision-making systems. Environmental education is characterised by key underpinnings, including a focus on learners of all ages, from early childhood to seniors. It emphasises the importance of experiential, interdisciplinary education, and helping all learners develop problem-solving and decision-making skills; understand how to be a civically engaged citizen; and how to create a more diverse, inclusive, and equitable society.[5] Thus, lifelong environmental education has an important role to play in making the environment and sustainability a central part of global society.

Each day people make decisions that affect the environment – from how they choose to travel to what they choose to eat and what products they choose to buy. It is imperative, then, that the public understand how their actions and lifestyles intersect with the environment.[3]

The aim of public environmental education is to increase awareness and knowledge about environmental issues or problems, and provide individuals with the knowledge, skills, attitudes, motivations and commitment to work individually and collectively to make informed decisions and take responsible action. It has been clearly shown that well-designed environmental adult education, such as outreach programmes, can lead to sustainable behaviour, promote public support for conservation, reduce poaching and reduce vandalism in protected areas.[9,10,11]

PUBLIC ENGAGEMENT

The goal of greater sustainability will not be met without engaging all members of society. We need to acknowledge, respect and make use of the existing knowledge of individuals. At the same time we need to challenge assumptions, provide opportunities for critical reflection and deal with feelings of fear, confusion and powerlessness.[12] As Clover (2002) suggests:

"We also need to work within a framework that is not based solely on science, but rather identifies the ways in which environmental problems result not from individual inadequacy but are rather a necessary by-product of capitalism… We need to use the rest of nature as teacher and site of learning, not just as a place of 'facts' and 'names.' Learning is situational and contextual, and there is a wealth of knowledge and experience out there, if we choose to use it."[13]

Whether environmental education is delivered as part of the national curriculum to primary and secondary students; an aspiring environmental scientist undertakes an environmental science degree; members of the general public participate in well-designed environmental outreach activities; or we find impromptu teachable moments on a nature walk with our families and friends, it is clear that environmental science education has value over and above any economic benefits. Tomorrow's leaders need to be equipped for the environmental challenges they will face, and it is imperative that we adequately prepare our children and wider communities for the future they will inherit. Widespread environmental literacy is crucial to empower communities to successfully deal with the global environmental challenges that lie ahead. **ES**

Dr Michelle Hale is Head of the School of the Environment, Geography and Geosciences at the University of Portsmouth and co-Vice Chair of CHES.

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OPINION

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Widening the appeal of the environment

Danielle Kopecky talks to environmental campaigner **Mya-Rose Craig**, known as Birdgirl, about diversity in the sector and the role of young people in the environmental movement.

Where do you think your passion for the natural world first came from?

I have always had a strong connection with the natural world. My older sister and parents are avid birders and they would often take me out birdwatching as a small child, meaning that I spent a lot of time throughout my childhood outside in nature. For as long as I can remember, I have gone out into natural spaces and the natural world has been a really important part of my life.

Your nature camps for young people aim to increase their engagement with the natural world. Could you give an overview of these camps and your organisation Black2Nature?

There is a significant lack of diversity, in particular ethnic diversity, when it comes to the types of people who spend time in the countryside, study subjects such as zoology or environmental science at university, or work in environment-related jobs. Black2Nature aims to provide an opportunity for young children and teenagers, particularly from visible minority ethnic (VME) backgrounds, to go out into natural spaces and spend time in nature, quite often for the first time. I set up the organisation when I was 14 years old and, to date, we have organised 12 nature camps, with activities including birdwatching, bird ringing, mothing, bioblitzing, nature art and photography. Through the camps, we hope to engage kids in nature in a way that they wouldn't typically have the opportunity to.

What changes have you observed in the way that young people engage with nature through their participation in these camps?

The biggest experience for the kids who take part in our camps can often just be spending a weekend out in the countryside, which is frequently something that they haven't had an opportunity to do before. A typical activity that is run at the camps is mothing, and it's always great to observe how kids who begin a session completely terrified of the moths and unwilling to go near them will often by the end be happy to have a moth close to them or sitting on their hand. There is a wider issue of acclimatisation to things that are very unfamiliar and therefore quite intimidating, which we are trying to address.

We aren't trying to make naturalists or birdwatchers out of the kids who attend the camps, what we're trying to do is to give them a new experience. Those who take part in the camps may not necessarily have the resources to go back out into the countryside. However, we hope that they are left with a heightened awareness of nature around them and, even in the city, they start to notice and engage with nature on their doorsteps.

What do you think are the barriers preventing young people, particularly from VME backgrounds, from engaging with nature and the environment?

It is a very complicated issue. We often talk about communities as a whole but it is important to remember that each community has a different cultural background. There are a number of barriers that might stop people from engaging with nature. These range from relatively minor barriers, such as a cultural fear of dogs, which is often common within VME communities, to much larger issues, such as the perception of the countryside as very white, middle-class and elitist, which I think is a big issue in the UK.

You recently shared a platform with Greta Thunberg at the Bristol Youth Strike 4 Climate. What impact do you hope that young activists such as yourself and Greta can have on a younger generation that is becoming increasingly engaged with environmental issues?

We are living in a very exciting time at the moment because we are in an age of social media and the internet. Suddenly, millions of people around the world are able to educate themselves about environmental issues in a way that they would not have been able to do before. For me, it's incredibly inspiring to see so many people my age who care so strongly about environmental issues such as climate change that they are willing to go out and protest to make their voices heard. I think these voices are incredibly impactful and hopefully influential.

We have also seen a real change in attitudes around environmental issues, whereby these are no longer seen as slightly hippy, leftist concerns. For a lot of young people, environmental issues are taking centre stage and they are unwilling to budge on that.

Greta has done a great job, but by the western press building her up to such huge proportions, she is no longer seen as a normal person that you can emulate, but an icon. That's great, but it doesn't lend itself to ordinary teenagers from low socio-economic or VME backgrounds seeing her as a role model or someone they could be. I hope that by being VME myself, talking about the lack of diversity in the environmental sector and explaining the impact of global climate justice on the global south, I can reach disadvantaged teenagers and make them realise that if I can be campaigning for climate change, then so can they.

What do you think the role of young people should be in shaping how the environment is viewed by decision-makers?

More and more we are seeing the impact of young people in the UK as a strong and cohesive political force. As a new generation of voters, we are showing those in power that we care about environmental issues and refuse to see these concerns sidelined. It is important that we have young people of different backgrounds and political persuasions campaigning about climate change and biodiversity loss. This is because lots of politicians, especially on the right, primarily care about votes. We need young people, as we become older, speaking out about how environmental policy is their top priority when voting. This is the only way things will change.

A recent report found that just 3.1 per cent of environmental professionals, and 9 per cent of UK students in higher education studying direct feeder subjects to environmental professions, identify as non-white minorities. What do you think the barriers are for people from VME backgrounds studying or working in the environmental sciences, and what do you think should be done to overcome these obstacles to improve diversity in the sector?

In general, there is both a lack of awareness of the types of jobs that exist in the environmental sector and a lack of understanding of what environmental jobs entail. Both contribute to environmental professions not being considered as viable career options. One of the things we have been trying to do is to speak with these communities, especially parents, to increase their knowledge and understanding of the environmental sector and the career opportunities that are available.

Where students do have an awareness of, and a want to pursue, careers within the environmental sector, academic and financial barriers often prevent them from following this path. Many jobs will require

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applicants to have undertaken significant periods of volunteer work, or to have high-level qualifications to access entry-level positions. Coupled with the fact that there are more applicants than jobs, these issues present significant barriers to entering the sector. However, I think it is important for people to understand that we are disadvantaging the sector by not addressing the lack of diversity, and I believe we must work out ways to open doors to people from different sectors of society.

The benefits of the environment for our physical and mental wellbeing are well documented, yet figures show that mental health concerns amongst young people are increasing. What more can be done to encourage young people to spend time in, and connect with, nature?

In the UK, the traditional idea of what engaging with natural spaces looks like is going out with binoculars, observing, identifying and recording species. This simply does not appeal to everyone, especially young people. Yet there are so many new and exciting ways that we can engage with nature, be it through our phones or the internet – taking a photograph of a flower for Instagram counts as engaging with nature! It is important to understand that birdwatching and rambling don't do it for everyone. The idea that there are certain prescribed ways that we should engage with nature can be very off-putting for a lot of people.

Are you planning to continue studying into higher education and, if so, do you intend to study an environmentally related discipline at university?

I'll be starting university in 2021 to study politics and international relations. For a long time I intended to study zoology, but over the last few years I have developed a particular interest in the intersection between the environment and people, and I think that this is an incredibly important area for bringing about change. Through my campaigning, I have realised that not everyone needs to be a scientist to have a positive impact on the environment. If you care about the natural world, scientific study is not the only way that you can express that, and that's very exciting for me personally.

Finally, what message would you like to share with young people who may be struggling to engage with nature?

It is a lot less complicated than everyone makes it out to be – it can be as simple as visiting a green space. Whether that green space is a park down the road or in the middle of the countryside, to do so is still engaging with nature and provides endless benefits both mentally and physically. I believe that spending time in nature can be immensely enjoyable, even if the only wildlife around are squirrels and seagulls. ES

Mya-Rose Craig, who blogs as Birdgirl, is an 18-year-old British–Bangladeshi conservationist and environmentalist campaigning to stop climate change, ensure global climate justice and stop biodiversity loss. She also believes that we need to prioritise the human rights of indigenous peoples.
@BirdgirlUK

One Planet – One Life

Jan Maskell describes a project that helps young people to think about and work towards sustainable ways of living.

"I will walk and cycle more than I do now."

"Eat as much local and seasonal fruit and vegetables as possible."

"I will refuse more stuff that I don't need."

These are typical pledges made by year 6–8 pupils at the end of One Planet – One Life workshops run by Scientists for Global Responsibility, as ways that they chose to reduce their carbon footprints. The United Nations Climate Change Learning Partnership[1] acknowledged that 'Since children alive today will very likely live the whole of their lives with climate change, it makes sense that they should be prepared for this future'. UNESCO's programme of Education for Sustainable Development[2] notes that 'Primary and post primary schools are considered to be ideal environments for building capacity amongst young people to enact changes towards sustainability'.

SCIENTISTS FOR GLOBAL RESPONSIBILITY

Scientists for Global Responsibility is a UK-based organisation with about 700 members, including scientists, engineers and architects. Formed in 1992, its aim is to promote science and technology that contributes to peace, social justice and environmental sustainability. In 2017 it set up Science4Society, with science education activities for young people on its website as alternatives to those funded by arms, fossil fuels and other controversial industries. Science4Society also runs a Science Week in March each year, during which:

CASE STUDY

- Teachers are encouraged to consider the ethics of science and technology, and deliver activities that both engage and enable learning using Science4Society resources;

- Students can enter a competition. In 2020 the competition was TRASH (Take Responsibility and Show How), and it asked entrants to demonstrate ways in which they had reduced their carbon footprint. The competition promoted some of the resources similar to those in the One Planet – One Life workshops; and

- Visits to inspiring venues are arranged. These have primary, secondary and university students visiting an eco-cohousing project, for example.

BOX 1. FUNDING FOR PROJECTS

One Planet – One Life workshops have been running since March 2019 in North Lancashire and South Cumbria with money from Ørsted's Walney Extension Community Fund. The Walney Extension offshore windfarm is located approximately 19 km west of Barrow-in-Furness in Cumbria, off the north-west coast of England. The STEM Education Fund was part of Ørsted's Skills Fund, which had the overall aim of paying for educational and learning opportunities for people within the Fund's benefit area.

THE PROJECT'S AIMS

As Scientists for Global Responsibility's Education Director, I developed Science4Society, drawing on experience in learning and development gained from academic study, educational roles and facilitating workshops with adults and children. Learning through doing is the key approach in all Science4Society's activities, with an emphasis on games wherever possible. As Vygotsky said, play allows children 'to be at their best'.[3] Many educationalists view games as a pedagogical tool that promotes a positive environment for learning,[4] so taking an integrated learning-through-playing approach can improve children's knowledge.[5]

The aims of One Planet – One Life workshops are to enable the participants to understand:

- The impact of individuals on the planet;
- The idea of carbon footprints;
- The components of their own carbon footprints; and
- The importance of behavioural choices.

Materials and exercises were developed based on tried-and-tested models used with groups, individuals and organisations, and they were piloted with groups of young people. Using a variety of exercises and media, the workshops covered the key topics that contribute to an individual's carbon footprint: home/energy, travel, food and waste. Individual and small group activities,

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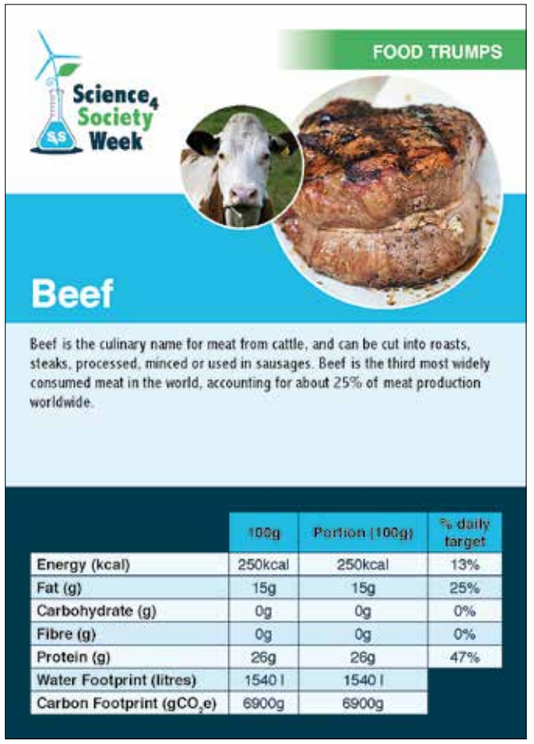

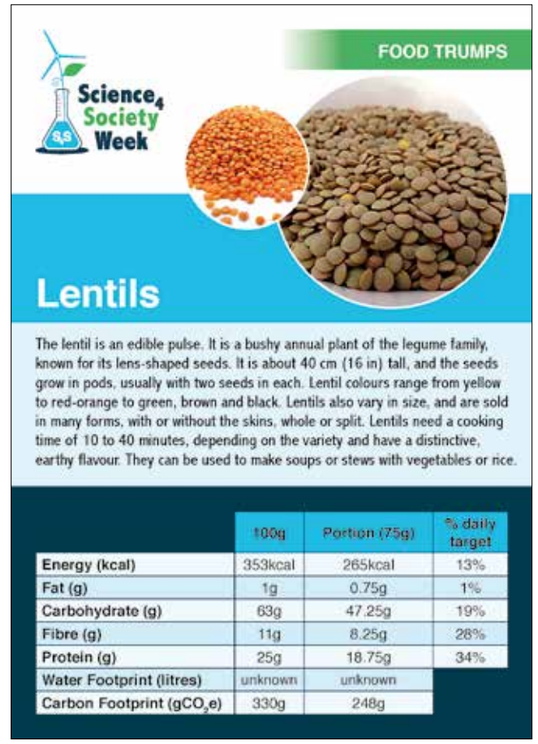

▲ **Figure 1. Food-based trump style cards, which display the carbon and water footprint for a typical portion and 100 g of common foods, are used in workshops to highlight the differences between animal-derived and plant-based foods. (© Scientists for Global Responsibility)**

interactive games, discussions, quizzes and videos were all used to promote understanding and encourage behaviour change. The aim was to create a learning environment that:

- Stimulated thinking;
- Helped to share ideas creatively;
- Provided information about climate change and carbon reduction; and
- Offered a chance to choose what personal changes to make.

STRUCTURE AND RESOURCES

The workshop activities started with a definition of climate change (using a short YouTube video) and what a carbon footprint is to emphasise that our individual contribution to climate change can be measured in CO_{2e}. The World Wide Fund for Nature (WWF)'s online carbon footprint calculator was used to calculate the footprint either of an average of the group or of one of the teachers. Calculating a teacher's carbon footprint can be quite illuminating – for them as an individual and to prompt the students to think about what their own footprints might be. For example, if their teacher drives a short distance to school every day, flies frequently or spends more than £150 a month on new clothes, the young people might start to question these actions.

The activities in the workshop were designed to be a mixture of individual and group work, and to use movement where possible. One example of this was the travel bingo game. A bingo card was created with 16 statements, such as:

- Somebody who cycles to work/school.
- A person who goes on holiday in the UK.
- A person who enjoys walking.

The statements have to be tailored to the school, so a town-centre secondary school would have students who travel there on foot, by bike, on the school bus and by car. A small rural primary school, in contrast, may not be served by a bus, so statements needed to reflect this. This activity asked students to collect four different names to make a complete horizontal, vertical or diagonal line. That meant the students had to move round the room – and the energy levels, and noise, quickly rose! A small prize was given for a line and for

a full card before a discussion about the implications of the different types of travel and their relative footprints.

Science4Society has produced a set of food-based trump cards (see **Figure 1**) for a range of common foods. These include nutritional information and the carbon and water footprints for a typical portion and 100 g. The cards can be used in small groups to play a short game of food trumps, with the rule being to only look at the carbon footprint. These sorts of games can also be used in other lessons and can highlight the differences in carbon footprint between animal products and plant-based foods.

When looking at waste, the students were first introduced to the 7 Rs hierarchy:

- Refuse – say no to more or new stuff;
- Reduce – cut down on what is used;
- Reuse – what someone else may no longer want or need;
- Repair – mend;
- Repurpose – turn it into something else;
- Rot – compost; and
- Recycle – paper, glass.

In groups, students were given picture cards and had to decide how far up the hierarchy they could put the items, e.g. plastic carrier bags could be reused but refusing them would be better. This activity could be run as a quiz or a competition between the groups to see who could place the most items higher up the hierarchy.

EVALUATING THE RESULTS

Evaluation is an important part of the workshops, both for Scientists for Global Responsibility and for the funders. There are two main ways this was done.

The first was a simple knowledge test, where students were given the same four statements at the start of the workshop and then at the end:

- I know what causes climate change.
- I know what a carbon footprint is.
- I know how to calculate my carbon footprint.
- I know what I could choose to do to reduce my carbon footprint.

They were asked to mark their responses on a scale from 'not at all' to 'completely' with different-coloured sticky dots – using red dots at the start and green dots at the end. The movement in claimed knowledge could be seen in any changes from red to green.

For the second type of evaluation, at the end of the workshop students were asked to think about what actions they could take and to choose what pledges they were prepared to make to reduce their carbon footprints.

These evaluations addressed learning and behaviour during workshops. In future, it would be even better if it were possible to engage for longer with schools to consider what projects they could deliver. These could be in relation to the school reducing its carbon footprint or the pupils sharing what they have learned through, for example, an assembly or poster campaign.

The feedback from teachers and schools has included comments such as 'That was new to me too!', 'The pupils were still talking about this days after the workshop', and 'You have started new conversations about these issues'. In addition, most of the schools requested workshops for subsequent years.

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CHALLENGES AND SUCCESSES

Enquiries prior to running the workshops had indicated that schools would be interested in a one-day event for years 7–9. However, this was not always the case when dealing with individual schools. The first challenge was gaining access to give information about the offer and then arranging workshops. These difficulties were around:

- Finding out the best person to speak to in the school;
- Getting past the 'gatekeepers'; and
- Getting replies to calls and emails.

The initial design was for a workshop that would last one day and be run for a class-sized group (25–30 pupils). However, in response to requests from schools, Scientists for Global Responsibility ran workshops in various formats, from a full day with a whole year group to a two-hour session with a hand-picked group.

Given some of the issues engaging with some of the secondary schools, agreement was gained from the funders to run the workshop with year 5–6 pupils in primary schools as well. This approach proved very successful, as primary schools were more flexible in accommodating workshops and the activities needed very little amendment to be suitable for this age group.

WHAT NEXT?

Scientists for Global Responsibility is currently looking to obtain funding to be able to deliver workshops to schools beyond the area covered by the Walney Extension Community Fund. It was always the intention to produce a facilitator training programme, and Scientists for Global Responsibility is currently seeking further funding to design, develop and deliver a train-the-trainer module. The aim would be to teach facilitators to deliver the One Planet – One Life workshops, either for Scientists for Global Responsibility or as independent trainers. These could be teachers or others who work with young people, and could lead to a cohort of facilitators supporting each other and sharing resources.

As a result of Covid-19 and the closure of schools during lockdown, in March 2020 the project was put on hold for nine months, with the agreement of the funders. When workshops resume in early 2021, it may be necessary to redesign the format of exercises to align with safety guidelines, while ensuring a continued emphasis on learning through play and encouraging young people to think about how they can reduce their carbon footprints – and share their knowledge with family and friends.

In the light of campaigns such as #BuildBackBetter, it is important to ensure, in our Covid and post-Covid world, that workshops such as these continue when environmental considerations could easily be put onto the back burner. ES

Dr Jan Maskell CPsychol MCIPD PIEMA is a Registered Occupational Psychologist, with more than 20 years' experience of facilitating, designing and delivering workshops for adults. She is the Education Director and Vice Chair of Scientists for Global Responsibility, a university tutor, a Carbon Conversations facilitator, the British Psychological Society's Going Green Working Group convenor. Jan also helps organisations implement environmental management systems.

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Environmental science: an A-level for the 21st century

Richard Genn makes the case for the future-proof A-level that promotes critical and scientific thinking.

A-level environmental science has been taught for longer than many people realise: the first exams took place in the late 1970s. I started teaching environmental science in 1980, my first year as a teacher. I am writing this in my last year of teaching. So this is a good time to reflect on how the subject has changed and where it may go in the future.

It took quite a long time (for me at least) to really understand what the subject was about. I gradually realised that it is not just a collection of isolated issues related to the environment, but is instead a wide range of interconnected issues where a common approach can be taken to help understand and solve problems. To do this it is necessary to:

OPINION

- Understand the resources and services provided by the living and non-living components of the planet;
- Understand how human actions affect these;
- Plan strategies to minimise negative impacts; and
- Monitor these strategies by collecting reliable data.

This is where scientific methodology becomes a core skill that A-level environmental science emphasises: questioning existing knowledge, testing the validity of new data and investigating all possible explanations.

▼ **Predictions of the impact of climate change on Antarctic ice change when new research results become available. (© Louise Porter)**

OPINION

▲ **Many problems caused by pesticides were not predicted because their properties were not fully understood. (© Mike Mareen | Adobe Stock)**

CHANGING APPROACHES TO LEARNING

A danger in science education can be that the curriculum involves learning facts that have been discovered in the past. It is questionable whether this is really science – it could be viewed as the history of science because of the lack of focus on the analytical thought processes involved in how the facts were established. Students are often presented with striking 'facts', such as:

- The Gulf Stream has lost 15 per cent of its strength since the mid-20th century;
- 7,900 km^2 of the Amazon rainforest was destroyed between August 2017 and July 2018;
- Greenland and Antarctica lost 6.4 trillion tonnes of ice from 1992 to 2017; and
- A million species are threatened with extinction.

If students are told these statements as facts and just accept them, then we are failing to help them to become scientists. Development of their scientific skills should focus on how they question the statements:

- How do we know that?
- Who collected the data?
- Where?
- When?
- How?
- Over what timescale?
- How much data has been collected?
- How confident can we be in the reliability of the data?

At some time, hopefully soon, there will be a shift in education away from learning facts, often with limited associated understanding, towards developing the skills to use them. Facts are obviously very important, but is the ability to remember them in exams really the best way to assess the abilities of young scientists? In the days when the most accessible facts were often in your memory, learning them was very important, especially when other sources were not readily available. But now, the most accessible source of knowledge is the smartphone in your pocket or the computer on your desk, so there can be a shift to a more balanced approach: developing skills, supported by the facts that create good judgments. The key skills needed nowadays are:

- To know that the facts exist;
- Where to find those facts; and
- How to use them.

If this approach were applied more generally in education then perhaps it would be a better preparation for the demands of employment.

THE 'DETECTIVE STORY' PROBLEM

Another danger in science education is the way that discoveries are presented. Studying science usually involves a body of knowledge that unfolds over time, starting with an initial problem and ending with the best explanation or solution. There are often theories that prove to be wrong and gaps in knowledge that may be filled after the knowledge was needed or before their significance was appreciated. But when the story is rearranged and structured for teaching, the details are often re-ordered to create a simple sequential story. False trails are omitted. Certainty may be implied, as if the scientists knew exactly where the research would lead, when at the time there was actually *un*certainty. The title of the topic is often the endpoint, not the starting point, giving the impression of a clear path to follow to reach the predicted outcome.

This would be like publishing a crime thriller where the title is the name of the guilty party. Examples from the topic of pollution, where the title gives away the cause, include CFCs and ozone depletion, organochlorine pollution and lead pollution. By contrast, the approach taken in A-level environmental science focuses on the properties of substances that eventually caused problems. An understanding of these can then be used to predict and prevent problems that may be caused by new materials.

A FUTURE-PROOFED A-LEVEL

Many young people are acutely aware of the need to understand environmental problems and that acting to reduce them is becoming more and more urgent.

OPINION

The campaigns led by Greta Thunberg and others are evidence of this. But it is not enough just to join a worthy campaign without questioning the strategies. A-level environmental science attempts to provide sufficient detail to make informed decisions.

There are few if any other A-levels where the knowledge base is so close to the edge of human understanding. As new information becomes available, there is a constant need to re-evaluate past conclusions. This provides a perfect context to help students develop their analytical and evaluative skills.

The syllabus for environmental science was written in a way that makes it as future-proof as possible. The principles that must be understood are stated, but the examples that may be used to illustrate these are not, so recent changes in the subject are valid in exam answers. This makes it clear that environmental science is a dynamic subject where our knowledge is constantly changing. It also helps to extend learning beyond the classroom, since what the students see and read on environmental issues outside of lessons can be used to expand understanding and improve exam answers. At the time of writing (September 2020) a few recent relevant events and news items include:

▲ **A-level environmental science emphasises data-collection methods, including the use of remote sensing and imagery using satellites and drones, which are becoming a standard method for surveying. (© Alexander Kolomietz | Adobe Stock)**

- Forest fires in the USA;
- An oil spill in Mauritius;
- Biodiversity loss;
- CO_2 emissions of plug-in hybrid cars;
- A green post-Covid-19 economy;
- Ice loss in Greenland and Antarctica;
- Control of neonicotinoid use;
- Health impacts of pollution in the European Union;
- Future lithium and neodymium supplies; and
- Use of drones and remotely operated vehicles (ROVs) in research.

“There are few if any other A-levels where the knowledge base is so close to the edge of human understanding.”

TRANSFERABLE SKILLS

During open evenings at the college where I teach, we encourage all students and parents passing by to come in to the environmental science room. We’re often met with: ‘My daughter/son doesn’t want to do environmental science. She/he wants to be a doctor,’ so I try to explain what environmental scientists do:

- Identify an issue or problem;
- Collect as much relevant information on it as possible (although there may be gaps in knowledge);
- Use this knowledge to plan a strategy to solve the problem (there may not be enough time to wait for more information before acting);
- Implement the strategy; and
- Monitor progress and update the strategy as necessary.

That is what doctors do. The intellectual approach to tackling environmental problems is exactly the same as diagnostic medicine. It is also applicable to business management, engineering, architecture, running a home and parenthood!

If students choose A-level environmental science, the subjects they combine it with depend on their future plans. The majority are interested in the natural world, so they often choose biology, geography and chemistry, and sometimes maths or physics. Another large group includes those students who do not have a specific career plan and want to keep their options open by choosing a range of interesting subjects that will help them with skills development more than knowledge acquisition. A minority of students start A-level environmental science with a definite aim of taking it further in higher education, and many others have decided to do so by the time they are applying to universities.

THE FUTURE OF A-LEVEL ENVIRONMENTAL SCIENCE

The new A-level environmental science syllabus was first examined in 2019, so it is too early to know how rapidly uptake is expanding, but it seems likely that its popularity will increase as environmental issues become more of a priority for governments, industrialists and the public. In the UK, there are some practical obstacles that make expansion of the subject more difficult. Once established in a school or college, environmental science often becomes very popular, but while it is becoming established classes may be small. This creates a financial obstacle, especially in schools where sixth forms are often small anyway.

There is a vicious circle for A-level subjects with a relatively small number of students. They are not attractive for publishers as they will have smaller textbook sales. This reduces the number of resources available to teachers and makes setting up the subject in a school more challenging. There are many useful websites, journals and magazines, but few are in a form that is ready for classroom use.

Environmental science is not listed as a STEM subject, despite science, technology, engineering and maths being at its core. This gives the subject a lower academic status than it deserves. A-level environmental science also draws upon a wide range of other subjects, including biology, chemistry, physics, maths, geology, geography, engineering, economics. The interdisciplinary nature of the subject is important because the best new ideas often arise when different disciplines meet. Using the expertise of those who work in other subjects also generates a greater sense of team spirit.

In preparing for writing this article, I typed, 'What is science?' onto a search engine and got 4,480,000 hits, so there are obviously plenty of opinions. The response I especially liked was from a university in the USA:

- Science is both a body of knowledge and a process;
- Science is exciting;
- Science is useful;
- Science is ongoing; and
- Science is a global human endeavour.

I think environmental science scores highly in all of these.

Environmental science is not offered as a distinct pre-A-level subject in schools, so it is unfamiliar to many students when selecting their A-levels. This has become a bigger issue since AS-levels have been phased out – those gave students a chance to try a fourth subject in their first year of A-levels. Many students chose environmental science then decided to carry on with it to complete the full A-level.

Despite these obstacles, there is a clear growth in interest in environmental issues. This extends beyond outrage at environmental crises, although this is justified. It also includes a growing desire for deeper knowledge based on the best information available. This is a demand that A-level environmental science is well placed to satisfy.

WHO SHOULD STUDY ENVIRONMENTAL SCIENCE?

There would appear to be several main groups:

- Those seeking a future in an environmental career;
- Those wanting to study a relevant, current, interesting subject;
- Those wanting to develop valuable transferrable skills; and
- Anyone intending to live on planet Earth. ES

Richard Genn is pictured below with the last male northern white rhino in Ol Pejeta Conservancy, Kenya. After a degree in Applied Biology at Bath University, three years as a research technician and a PGCE in Biology, Richard got a job teaching environmental science without really understanding what it was – but it was a lucky choice. Richard has also been a senior examiner and is author of the current environmental science textbook.

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© Angela Genn

◀ **Vertical axis wind turbines. The use of new technologies to solve environmental problems is emphasised throughout the syllabus. (©YuanGeng | Adobe Stock)**

New pathways into the profession: environmental apprenticeships

Jackie Rogers and **Caroline Sudworth** review the opportunities for combining study with on-the-job experience.

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FEATURE

In 2015 the Conservative government, in their general election manifesto, committed to creating 3 million new apprenticeships by 2020. The government placed employers at the heart of the apprenticeship system by introducing an employer-funded apprenticeship levy. Since 6 April 2017, all UK employers with a payroll of more than £3 million per year have paid 0.5 per cent of their pay bill, minus an apprenticeship levy allowance of £15,000 per financial year, into an apprenticeship service account. The money has to be spent on apprenticeship training and assessment.[1] Non-levy payers can apply to access apprenticeship funds to be used in a similar manner.

Prior to this, apprenticeships had not always been valued either by the apprentice or the employer. In 2011 the coalition government commissioned Doug Richard, entrepreneur, educationist and former *Dragons' Den* dragon, to undertake a review of apprenticeships in the UK. In 2012 he published his independent report,[2] in which he called on the government to improve the quality of apprenticeships and to make them more focused on the needs of employers. At the launch of his review, Doug Richard said:

"Apprenticeships need to be high quality training with serious kudos and tangible value for both the apprentice and the employer. I want to hear about an 18 year old who looked at their options and turned down a place at Oxbridge to take up an apprenticeship if that is the right path for them. And I want to hear that their parents were thrilled."[3]

The government welcomed the report, with the then Business Secretary, Vince Cable, saying:

"Doug Richard's review echoes the Government's current thinking on putting employers in the driving seat of our apprenticeship programme. This will be vital to ensure the skills of our workforce fit with employer needs.

His recommendations will help us to build on the current successes of our apprenticeships programme and tailor a programme which is sustainable, high-quality and meets the changing needs of our economy in the decades to come."[3]

The Richard review resulted in a wholesale change in the way apprenticeships are developed and approved.

EMPLOYERS IN THE DRIVING SEAT

Fast forward to 2020. With employers now in a position to determine the apprenticeships they need, combined with the drive to spend their levy, apprenticeships have come to the fore. Degree apprenticeships, where a degree-level qualification is achieved through an apprenticeship, have been warmly welcomed by employers seeking to develop the higher-level technical and professional skills needed for future growth.

As of 1 September 2020 there were 84 degree apprenticeships approved for delivery across a huge range of sectors and occupations.

Employers in the growing environmental sector are looking for the next generation of highly skilled environmental practitioners. With the decline in the number of enrolments onto physical science undergraduate degree courses (including environmental science),[4] the new degree apprenticeships offer an attractive and affordable solution for skills training.

TRAILBLAZER GROUPS

The new approach to developing apprenticeships requires employers and relevant professional bodies to collaborate, through trailblazer groups, to develop apprenticeship standards, complete with mandatory end-point assessments (EPAs) of occupational competence. Employers representing the environment sector have been actively engaged in trailblazer groups, and key outputs have been two degree-level apprenticeships: environmental practitioner (level 6) and ecologist (level 7).

The first aims to attract new talent into the sector, with entry directly from schools or colleges (with apprentices typically holding A-levels or BTECs). The apprenticeship takes them through an accredited undergraduate degree programme in tandem with a job, to develop their occupational competence over a period of 4–5 years.

"I want to hear about an 18 year old who looked at their options and turned down a place at Oxbridge to take up an apprenticeship if that is the right path for them. And I want to hear that their parents were thrilled."[3]

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The second aims to support businesses to specialise their staff (and recent graduates), with these post-graduate apprentices completing a masters-level programme while developing the competences required for chartered status in the field of ecology.

While the ecology apprenticeship is restricted to a smaller number of employers, the environmental practitioner degree apprenticeship has been designed and developed to offer a wide range of employers the opportunity to attract and retain new talent, while changing the way the entire sector recruits and develops the workforce for the future.

DEVELOPING THE LEVEL 6 APPRENTICESHIP

In 2017, a trailblazer collaboration led by WSP, Waterman and Mott MacDonald presented a vision to (what is now) the Institute for Apprenticeships and Technical Education (IfATE; now an independent body associated with the Department for Education) of a new route into environmental careers across the breadth of the sector using an apprenticeship containing an appropriate undergraduate degree. After 18 months, the work of these employers and 22 others, including representatives from professional bodies, culminated in the development of:

1. An apprenticeship standard: a document that outlines the occupational role, the likely entry requirements, typical length (4–5 years for a new recruit), and the mandatory degree qualification, complete with a set of knowledge, skills, and behaviour statements (KSBs) that are independently assessed for each apprentice at the end of the formal training, which is called 'off-the-job training'; and

2. An end-point assessment (EPA) plan: a document that outlines how each apprentice's competence will be assessed at the end of the formal training. Apprentices and their employers can opt for a simultaneous professional review with a registered environmental professional body.

In June 2019, the government approved the apprenticeship, providing a route for employers to recruit new apprentices or upskill existing staff, while accessing apprenticeship funding (to a maximum of £27,000).

LAUNCH OF THE FIRST PROGRAMME

During the spring and summer of 2019, members of the trailblazer group worked with a number of universities to enable the launch of the first programmes. In September 2019 the first apprenticeship training programme was validated and launched at Kingston University, in south-west London. Six employers placed 12 apprentices onto the degree apprenticeship programme, BSc Environmental Science, using a day-release model.

Kingston University encourages work-based mentors to support the apprentices' experience on the job while engaging with their academic learning first hand. Work-based mentors are able to monitor lectures, topics and seminars and use these in the workplace. The university's academic programme lead, Dr Penelope Wilson, commented:

"Work-based mentors have matched jobs and projects in the workplace to their current academic course material and subjects. It's great to see them taking such good care of their apprentices and trying to develop their learning in their workplace."

THE APPRENTICE EXPERIENCE

With the first year of Kingston's programme now complete, apprentices' reports are positive, despite the challenges of combining work with study and the added complexity of Covid-19, as these quotes from the first cohort demonstrate:

"This apprenticeship has been amazing. I've had the chance to work on amazing projects across the globe and contribute as much as I can to these projects. I look forward to what the future holds."

"Everyone in the team has been so supportive and they are always willing to help out and show you something new. Since joining, I have already been presented with so many opportunities to learn and grow professionally and I am so excited to continue expanding my knowledge and skills across multiple environmental teams."

"I am loving the professional lifestyle, while also still being able to study and further my education alongside, which is the ideal situation in my eyes."

Degree apprenticeships are both a challenging and rewarding option for those who choose them. The blend of on- and off-the-job elements, providing real-life practical experience underpinned by knowledge and the latest thinking, is an attractive alternative to those who do not want to pursue a traditional 3- or 4-year degree.

WHAT THE EMPLOYERS SAY

WSP head of acoustics and chair of the trailblazer group, Louise Beamish, commented:

"This degree apprenticeship marks a hugely significant milestone for the environmental industry, and we were thrilled to have been involved in it from the beginning. We very much hope this will become a primary route to an environmental degree while gaining valuable vocational skills."

Degree apprenticeships are a win–win for apprentices and employers. Employers stand to gain from new ideas

and approaches that act as a catalyst for transforming ways of working, and they can decide themselves how they wish to invest the apprenticeship levy according to their specific strategic priorities and skills gaps. As a result they have access to a continuous pipeline of talent. The 'earn while you learn' mantra has proved attractive to those who may not have considered university as an option, and therefore degree-level apprenticeships have the potential to widen the talent pool for employers.

THE FUTURE

Prior to Covid-19, more than 40 employers were seeking to place approximately 100 environmental practitioner apprentices across England from 2021 onwards. Whilst it is expected that there will be a significant scaling back of these numbers in the short term, employers will be looking to use their levy funds and to invest in apprentices. The demand is there. So there is the need for other universities to offer degree apprenticeship courses, to act as regional hubs offering block release programmes or maximum flexibility through online delivery.

Bolton University is developing one such course, where a block release programme is set to be delivered from 2021. Other universities, including the University of the West of England, are now engaging with employers to develop and refine their offer. The trailblazer group, working with the Environment Agency, is looking for additional university partners to broaden and strengthen the opportunities that will allow employers to place apprentices with them across all English regions. According to Waterman Infrastructure and Environment director and co-chair of the trailblazer group, Anna Bacon:

"The environmental practitioner degree apprenticeship is an exciting development helping to capture new talent and making vital inroads into the long-recognised resource shortfall across our industry. We look forward to seeing this initiative produce some exceptional new environmental professionals."

RAISING AWARENESS

For higher education institutions the greatest challenge in setting up the new-style apprenticeships has been tailoring course delivery and assessment to learners who are in full-time employment and undertaking a significant proportion of their learning in the workplace, rather than to full or part-time students in the classroom. However, working more closely with employers in the development of degree apprenticeship programmes offers a range of opportunities. The potential rewards are significant: academic programmes can be greatly enhanced with industry input and support, which in turn supports both apprentices and traditional undergraduates, and opens the door for longer-term industrial partnerships to be forged.

© Gorodenkoff | Adobe Stock

The successful scaling up of apprenticeships requires an increase in provision and more employers to create apprenticeship positions. Employers and professional bodies need to work together to:

- Encourage the uptake of apprenticeships by employers;
- Support, develop, record apprentices' occupational and professional competence; and
- Encourage the simultaneous professional and end-point assessment model through professional organisations.

With the introduction of the Society for the Environment's professional designation of Registered Environmental Practitioner (REnvP), now is the perfect time for professional bodies such as the IES, employers and university providers to collaborate and develop the programmes that can support and recognise a new generation of environmental practitioners.

Young people's awareness about degree apprenticeships is growing, but needs to be raised further. We all need to do more to promote these new opportunities for a career in the environmental sector. ES

Dr Caroline Sudworth joined the Technical Apprenticeship Consortium (TAC) as Apprenticeship Standards Consultant in July 2017. She is responsible for five trailblazer groups, which have developed eight apprenticeships, including railway engineering design, civil and building services engineering, transport planning and environmental practitioner.

Dr Jackie Rogers is a CHES executive committee member and the outgoing Chair. She is the Associate Dean for Learning, Teaching and Student Experience in the Faculty of Environment and Technology at the University of West of England, Bristol and is involved in the development and delivery of a wide range of degree apprenticeships.

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New members and re-grades

Member

is for those individuals who have substantial academic and work experience within environmental science.

Taiwo Hassan Akere – Researcher
Emmanuel Arthur – Environment & Sustainability Consultant
Amy Atkins – Analyst/Geochemist
Kerrie Baggs – Senior Environmental Consultant
Felicity Barnard – Remediation Consultant
Rosie Barnett – Regional Environmental Manager
Mark Boobyer – Geo-environmental Consultant
Rebecca Brownlow – Environmental Consultant (Air Quality)
Kirsten Campbell – Assistant Environmental & Sustainability Manager
Graham Carter – Engineering Geologist/Director
Fraser Chamley – Senior Geo-environmental Engineer
Sarah Clinton – Air Quality Consultant
Kathryn Collins – Senior Environmental Consultant
Sandra Coyne – Environmental Manager
Ellen Dempster – Managing Director
Jennifer Devlin – Associate Project Manager
Andrew Doerr – Associate
Gary Donaldson – Senior Environment & Sustainability Adviser
John Drabble – Sector Director, Environment Industry
Imelda Egan – Scientist
Kathryn Elliott – Environmental & Energy Consultant
Kathryn Ellis – Data Scientist
Stella Emeka-Ojika – Geo-environmental Consultant
Olusegun Fawole – Associate Researcher
Benjamin Firmin – Senior Environmental Protection Officer
Chi Ching Fong – Consultant
Marika Gates – Principal Environmental Scientist
George Gibbs – Associate Director
Shaleni Gopie – Senior Environmental Officer
Bruno Guillaume – Environmental Consultant
Thomas Hamments – Managing Director
Kate Hardy – Senior Environmental Consultant
William Hargrave – Environmental Scientist
Paul Harris – Senior Land Quality Officer
Rachael Henderson – Director
Joshua Higgins – Environmental Consultant
Arica Hill – Executive Director
Tomos Hole – Senior Air Quality Consultant
Nina Hurhangee – Environmental Consultant
Ufuoma Ilaya – Regional Compliance Officer (North & West)
Obinna Iwuchukwu – Director/Partner
Jacqueline Jones – Land Quality Principal (Water & Environment)
Justin Kmelisch – Associate Project Manager
Tin Lung Leung – Executive Officer 1 (Laboratory Safety)
Andrew Liggett – Environmental Specialist
Kevin Linden – Associate Assessor/Consultant
Darren Makin – Senior Engineer
Lauren Manning – Senior Consultant
Waqas Manzoor – Ecologist
Frances Marshall – Senior Consultant
William Mayes – Reader in Environmental Science
Ewan McLellan – Environmental Consultant
Victoria MeGraw – Geo-environmental Engineer
Jack Morfett – Senior Environmental Consultant
Jennifer Morley – Geo-environmentalist
Daniel Mullick – Senior Air Quality Consultant
Robert O'Brien – Carbon Lead Adviser
Joshua Okeke – Environmental Consultant
Andrew Pape – Senior Environmental Consultant
Paul Quinn – Senior Environmental Consultant
Charlotte Radiven – Associate Project Manager
Amy Ratcliffe – Senior Product Environmental Engineer
Anthea Rawcliffe – Associate
Christopher Rowett – Environmental Consultant
Christopher Sargeant – Postdoctoral Researcher
Waseem Shahid – Environmental Manager
Kellie Sheldrake – Principal Environmental Consultant
Rajeswaran Sivasankar – HSE Engineer
Elvis Tangem – Coordinator
Simon Tavner – Principal Land Quality Scientist
Keri Thomas – Explosive Ordnance Liability Assessor
James Thornton – Group Environment & Sustainability Manager
David Tompkins – Head of Knowledge Exchange & Innovation
James Trow – Managing Director
David Turner – Principal Consultant
Oxana Waite – Environmental Consultant
Shweta Walton – Environmental Team Lead
Hayley Warrens – Climate Change & Resilience Officer
Nicola White – Senior Hydrogeologist
Simon Williams – Soil Scientist
Kai Cho Stanley Wong – Environmental Manager
Muhammad Ali Zulfikar – Lecturer & Researcher

Associate

is for individuals beginning their environmental career or those working on the periphery of environmental science.

Eunice Agot – Senior Technologist
Rachel Archer – Graduate Permit Controller
Nathan Barrett – Graduate
James Barwick – Renewable Energy Technical Manager
Jacob Bennett – Environmental Monitoring Technician
Saama Biekpe – Graduate
Giorgia Bow – Senior Project Officer
Aimee Brown – Graduate Environmental Consultant
Matthew Carr – Geo-environmental Technician
George Chousos – Assistant Consultant
Jessica Cracknell – Graduate
Aislinn Crawford – Graduate Consultant (Environmental)
Uilani Dines – Fundraiser
Simran Dosanjh – Graduate
Beth Falconer – Global Operations Manager
Rachel Gaitonde – Graduate Environmental Consultant
Jessica Gallacher – Environmental Consultant
Christina Georgiadou – Environmental Consultant (Air Quality Specialist)
Samantha Giles – Environmental Engineering Professional
Catherine Gould – Air Quality Consultant
Joshua Hadfield – Associate Environmental Consultant
Roger Harris – Graduate Environmental Scientist
Victoria Harris – Ecologist
Elinor Hathaway – Environmental Consultant
Samuel Hawkins – Graduate
Patrick Hepple – Technical Support Associate
Myles Howard – Graduate Environmental Consultant
Zoe James – Project Support Officer
Robin Johnson – Head of Environment
Lorna Johnson – Geotechnical Engineer
Alexandros Konnaris – Environmental Engineer
Christopher Laing – Environmental Technician
Hannah Lederer – Environmental Scientist
Bérengère Levionnois – Graduate Environmental Scientist
Jonathan Marsh – Graduate Environmental Consultant
Graeme Martin – Assistant Environmentalist
Gary McClean – Graduate Geo-environmental Scientist
Joshua Mills – Assistant Air Quality Consultant
Samuel Murphy – Graduate Air Quality Engineer
Gemma O'Connor – Graduate Environmental Scientist
George O'Ferrall – Clean Air Zone Project Officer
Millicent Parks – Graduate
Daniel Paul – Senior Risk/Insurance Adviser
Isabel Pugh-Lewis – Graduate
Bethany Read – Graduate Environmental Scientist
Alex Riley – Postdoctoral Research Associate
Joshua Saunders – Landscape Assistant
William Savage – GIS Officer
Peter Seaton – Graduate
Alan Sewell – Process Support Engineer
Daniel Ward – Programme Lead

Affiliate

is for individuals with an interest in environmental issues but who don't work in the field, or for students on non-accredited programmes.

Maria Anton-Garcia – Technical Manager
Jonathan Aslin – Director
Emmanuel Atai – PhD Researcher
Suzanne Cooper – Horticulturist
Olive Dillon – Student
George Evans – Managing Director
Ashley Graham – Operations Manager
Liz Gray – Principal Consultant
Philip Home – Student
Lindsey James – Student
Jonathan Johnson – Environmentalist
Eva Kasza-Szalontai – Student
Jack Preece – Student
James Rebello – Student
Rebecca Robertson – Business Manager
Isabelle Wray – A-Level Student

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Education for sustainable development in higher education

Elizabeth Price, James Longhurst, Rehema White, Chris Preist, Kate Mori, Zoe Robinson, Patrick Baughan, Georgina Gough, Carolyn Hayles, Peter Higgins, Petra Molthan-Hill, Catherine Hack and **Simon Kemp** make the case for education that is relevant to all students' futures.

"Without significant precautions, education can equip people merely to be more effective vandals of the earth".[1]

In this article, we seek to set out some of the reasons why education for sustainable development (ESD) needs to be more deeply and consistently integrated in higher education curricula and outline how the forthcoming guidance from Quality Assurance Agency for Higher Education (QAA) and Advance HE on education for sustainable development will support educators to implement it.

Anthropogenic perturbation of climate change, biosphere integrity, biogeochemical flows and land system change exceed the proposed planetary boundaries that define a safe operating space for human societies to develop and thrive in.[2] In an era of climate and ecological emergency,[3,4] it is essential that we embed education for sustainable development in higher education curricula. Advocates for education for sustainable development argue that universities have a vital role to play in promoting sustainability through creating knowledge, transferring this knowledge to society and preparing students for their future roles.[5] Higher education has a responsibility to prepare graduates for the sustainability and environmental challenges they will face in their lifetimes. It should also equip them to be resilient, adaptable, skilled and knowledgeable, and give them agency to drive a better future as they face a changing climate. 'ESD aims at developing competencies that empower individuals to reflect on their own actions, taking into account their current and future social, cultural, economic and environmental impacts, from a local and a global perspective.'[6]

STUDENT EXPECTATIONS

Students who have been involved in climate strikes are, or soon will be, students in our universities, and increasingly, education for sustainable development has become one of their expectations:[7] in a survey of students, 88 per cent of respondents agreed their place of study should actively incorporate and promote sustainable development, while 80 per cent wanted to see sustainable development actively incorporated and promoted across *all* courses.[8] Student concern about climate change and other sustainability issues has been mounting: 91 per cent of survey respondents are concerned when asked, 'How concerned, if at all, are you about climate change?'.[9]

In addition, students have shown an increasing preference for a graduate role with an organisation that has a strong environmental and social record, even if that means a lower starting salary (75 per cent for a £1,000 reduction and 53 per cent for a £3,000 reduction in 2018–2019).[8] This expectation is exemplified by Teach the Future,[10] with students calling for a review of the education system to investigate how the climate crisis, climate justice and the ecological emergency are taught.

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Education for sustainable development is not merely about sustainability. While scientific knowledge and technological solutions are changing rapidly, providing students with competencies such as critical thinking will ensure that they can always adapt and co-create a resilient world. Furthermore, addressing education for sustainable development is integral to other higher education agendas, such as employability and the decolonisation of the curriculum towards more inclusive and diverse curricula. Nevertheless, curriculum change can represent a challenging aspect of the sustainability agenda because the activities needed to expand education for sustainable development in universities require them to go beyond traditional approaches of governance, learning and teaching.[7,11,12]

NEW GUIDANCE

The QAA quality code is used as part of the regulatory environment in the UK to assure the quality and standards of all higher education providers. Education for sustainable development guidance was first published jointly by the Higher Education Authority (HEA) and QAA in 2014,[13] and is a key reference point to assist in enabling providers to meet the expectations of the quality code.

Our understanding of sustainability has changed in recent years, driven partly by the Sustainable Development Goals (SDGs) and the connections between them.[14] The 17 SDGs address global challenges, including those related to poverty, inequality, climate change, environmental degradation, peace and justice (see **Figure 1**). The SDGs represent a compromise across agendas, society and governments, and although they are contested, they require attention by all nations and

▲ **Figure 1. The Sustainable Development Goals are designed to shift the world onto a sustainable and resilient path. They balance the three dimensions of sustainable development: economic, social and environmental. (© United Nations)**

sectors, including higher education.[15] It is clear that a much deeper, faster and more ambitious response is needed to deliver the social and economic transformation required to achieve the SDGs by 2030.[14]

All educators have a responsibility to consider how they facilitate the graduation of responsible citizens with a sense of purpose who can think critically and compassionately, within current and future contexts,

BOX 1. COMPETENCIES FOR SUSTAINABILITY

Systems thinking competency. The abilities to recognise and understand relationships; to analyse complex systems; to think of how systems are embedded within different domains and different scales; and to deal with uncertainty.

Anticipatory competency. The abilities to understand and evaluate multiple futures – possible, probable and desirable; to create one's own visions for the future; to apply the precautionary principle; to assess the consequences of actions; and to deal with risks and changes.

Normative competency. The abilities to understand and reflect on the norms and values that underlie one's actions; and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.

Strategic competency. The abilities to collectively develop and implement innovative actions that further sustainability at the local level and further afield.

Collaboration competency. The abilities to learn from others; to understand and respect the needs, perspectives and actions of others (empathy); to understand, relate to and be sensitive to others (empathic leadership); to deal with conflicts in a group; and to facilitate collaborative and participatory problem solving.

Critical thinking competency. The ability to question norms, practices and opinions; to reflect on own one's values, perceptions and actions; and to take a position in the sustainability discourse.

Self-awareness competency. The ability to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.

Integrated problem-solving competency. The overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive and equitable solution options that promote sustainable development, integrating the abovementioned competences.[6]

to influence change and make a difference in their community. The UNESCO key competencies for sustainability[6] (see **Box 1**) are competencies that are relevant across disciplines and contexts that enable students to become change agents, problem solvers and transition managers.[15,16] Sustainability education is aligned to transformative teaching (engaging head, hands and heart) to embed knowledge and information about sustainability issues and solutions, and deliver it so that students are able to engage practically and apply their learning in a way that allows them to see how they can make a difference.[17]

In recognition that the landscape has changed, QAA and Advance HE (formed from the HEA and other organisations to support strategic change and continuous improvement of higher education) commissioned an expert group to review and update the education for sustainable development guidance for publication in early 2021. The guidance will support educators by:

BOX 2. LEARNING CARBON LITERACY

Manchester Metropolitan University has worked in partnership with the Carbon Literacy Project since 2011, and has delivered carbon literacy learning to students and staff since 2012 to develop skills and knowledge for climate action and carbon reduction.[20] Carbon literacy training is embedded in the BSc (Hons) Environmental Science programme and in a number of other programmes across the university. It is also available to all students and staff as a free extra-curricular activity.

Manchester Met has pioneered the use of students as carbon literacy trainers and facilitators using a carbon literacy for staff and students (CL4SS) model that won a Green Gown Award. So far, the CL4SS model has seen over 1,500 Manchester Met students and staff become carbon literate. The impact of CL4SS has been amplified beyond the university, with Manchester Met student carbon literacy trainers delivering a workshop at the European Parliament in Brussels and presenting on carbon literacy at the UK Local Conference of Youth, which fed into the COP24 summit. The Manchester Met CL4SS course will be shared with all UK universities by the Carbon Literacy Project as part of their UK government-funded Public Sector Carbon Literacy Toolkit.

▲ The first cohort of student trainers for the Carbon Literacy Project receiving their certificates. (© Carbon Literacy Project)

BOX 3. SDGS IN THE CURRICULUM

In a project led by the Associate Professor in Education for Sustainable Development, staff teams at the University of the West of England (UWE Bristol), often with student involvement, have reviewed and reflected on ways in which their programmes enable students to engage with each of the SDGs. In some cases this extends to the potential contribution of the relevant profession to achieving the SDGs.

The expectation is that each programme will relate in some way to the full set of goals. The resultant programme map is used to inform curriculum design, delivery and enhancement. The maps have been displayed publicly and also used for programme promotion and accreditation. Some 80 programmes have completed or are undertaking the mapping exercise, including environmental science.

▲ A section of the programme map for UWE Bristol's BSc Environmental Science programme detailing how the course content relates to goals 1 to 6. For more information or to view the programme map in full, please contact UWE Bristol. (© University of the West of England)

- Identifying the people in institutions who should lead and engage with the aims and intentions of the guidance;
- Addressing the question of why education for sustainable development is critical to teaching and learning;
- Providing guidance on how to embed education for sustainable development in curricula; and
- Providing a range of resources to support educators.

RELEVANCE TO IES-ACCREDITED COURSES

The IES degree programme accreditation scheme[18] is closely aligned to the QAA's subject benchmark statement for earth sciences, environmental sciences and environmental studies (ES3).[19] This subject benchmark statement recognises that sustainability is a fundamental part of many subject areas associated with ES3 and is built into most of those curricula. Although many environmental science programmes embrace education for sustainable development guidance, focus on solutions, embed practice and seek to empower their students (see **Boxes 2** and **3**), the number of higher education institutions integrating education for sustainable development in curricula remains relatively limited.[7]

Environmental science draws on biology, chemistry and physics, and other disciplines, to identify, understand and resolve environmental challenges. We urgently need this specialised knowledge to address global sustainability issues. However, sustainable development, as demonstrated by the SDGs, is a much wider systemic framework that also includes the need for social justice and equality, decent work, an end to poverty and hunger, health and wellbeing. Through education for sustainable development, disciplinary excellence can come together with challenge-focused and competency-based education, interdisciplinary approaches and practitioners to more fully pursue sustainability.

Increasingly, higher education institutions are engaging in Responsible Futures to further embed education for sustainable development in their curricula. Responsible Futures is a whole-institution approach to embedding social responsibility and sustainability across the formal and informal higher education curriculum. It seeks to legitimise and mainstream education for sustainable development, ultimately helping to ensure students leave education with the knowledge, skills and attributes needed to lead society to a more just and sustainable future.[21]

CALL TO ACTION

The most significant sustainability impact a higher education institution will have is on the attributes of its graduates. According to actuary tables, a graduate leaving university will have some 60 years of life.[22] The skills, knowledge and, above all, the attributes that they develop in higher education can help achieve a more sustainable future. We advocate that IES members act as champions for education for sustainable development in their own institutions and use the new guidance to establish an approach to education for sustainable development that fits with their institution's culture and ethos. ES

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OPINION

Through a student lens: perspectives on environmental science degrees

George Bethell and **Mathilda Digby** outline the advantages they have gained from their academic and extracurricular experiences.

Environmental education is crucial for building a green society where people put the environment and the climate at the centre of decisions and policies,[1,2] especially as societies are becoming disconnected from their ecological roots. This results in a lack of consideration and awareness around the food we eat, the transport we use and the items we buy. Societies have also lost the understanding of what practices are necessary to protect the land, water and atmosphere from degradation for current and future generations. The study of environmental science provides students with an understanding of how we have shaped processes in the past. It can also equip them with the necessary skills to make positive changes to safeguard the future in a wide range of environmental situations.

▲ **Species identification is a valuable part of the skillset I am developing at university. (© Mathilda Digby)**

AN UNDERGRADUATE PERSPECTIVE

SKILLS THAT GO BEYOND THE DEGREE COURSE

In just two years of study for my undergraduate degree in wildlife ecology and conservation science, I (Mathilda Digby) have learned and been exposed to an abundance of skills relevant to work in the environmental sector. These include environmental surveying, writing environmental reports, species identification, creating habitat and species management plans and using data and spatial analysis software, including ArcGIS Pro, RStudio, SPSS and Excel. These skills are being taught through a combination of theory, laboratory-based practicals, computational analysis projects and regular fieldwork. In addition, assignments are designed to encourage independent survey design, collection and analysis of our own data, and creating scenarios applicable to potential future working situations.

Throughout there has been an emphasis on written and verbal science communication. As well as the expected requirement for written work in a variety of formal and informal writing styles and frequent oral presentations, this has manifested itself in the form of networking with academics and research scientists at events. I have also had to communicate successfully with a team on a project while collecting data. All of this has developed my communication skills and the confidence to articulate my own findings and theories.

While these skills are vital for securing employment, I believe that a degree offers so much more. Transferable skills run throughout the course and are applicable to many situations. These include teamwork, problem solving, time management, the confidence to network, and the persistence to keep trialling ideas and methodologies even when they seemingly bring you to dead ends.

IT'S WHO YOU KNOW, NOT WHAT YOU KNOW

Networking is the most valuable skill I am developing at university. It is allowing me to interact with people from all sectors within science and outside it, to exchange information and develop professional and social contacts. Attending conferences is opening up perspectives that I had not thought of before, ultimately expanding my knowledge and providing avenues for me to develop my ideas and hypotheses.

Through attending film festivals, conservation events, conferences and symposiums, I have met many talented people who have later asked me to help them on their projects. At a Conservation Optimism film festival, I met a master's student who later asked me to help transcribe interviews about marine protected areas that she had carried in South Africa. At a symposium I attended for the protection of global ecosystems, I met people from the governmental sector, academics, wildlife trust representatives, people running their own conservation projects and a member of the IES, who later put my name forward to co-author this article.

Networking is an extremely valuable tool to have post university, so it is something that everyone should practise at university. As mentioned above, it is not always a case of what you know but the connections you have made within an organisation. For example, by making yourself known within a company, you become a face rather than just a name on an application, often giving you an advantage over other candidates. Networking can be a daunting step to take but it can bring many rewards that far outweigh the initial steps required to get there.

THE BENEFITS AND VALUES OF VOLUNTEERING

Volunteering is an excellent way to explore different situations. It provides tasters of avenues that you would like to pursue a career in and those that would not suit you. Often, a university will affiliate with organisations that you can volunteer with, but you can also find your own projects through local wildlife trusts and conservation organisations, websites such as LinkedIn or the people you meet when networking.

Volunteering comes in a variety of forms, ranging from outdoor manual work to working with children, helping with data collection and analysis for someone else's research or working with data input and spreadsheets. In my second year I carried out weekly woodland management and restoration at Stoke Park Estate in Bristol. Our work contributed to the estate's restoration and improvement plan to enhance and maintain existing habitats.[3] I helped to reduce the canopy cover by 30 per cent in some areas, slow the spread of invasive species such as cherry laurel (*Prunus laurocerasus*) and clear historical monuments of surrounding vegetation. We also spent time learning bushcraft skills and foraged for wild foods such as hawthorn berries (*Crataegus* sp.) to make ketchup, wild garlic (*Allium ursinum*), beefsteak fungus (*Fistulina hepatica*) and more. This increased my identification skills and reconnected us as a group to our ecological roots.

Through my summer holidays I volunteered at Bristol Zoo. I carried out behavioural analysis of four South American fur seals (*Arctocephalus australis*) for a master's student's research into the effects of social group management on individual welfare, social interactions and breeding capabilities. Two days a week I would monitor the seals' interactions and movements around the enclosure. I would also talk to children and families visiting the enclosure about science and research for the protection of wildlife as well as the seals and their behaviour. I discovered that while I enjoyed interacting with the public and monitoring the four seals, I am more interested in ecosystem function and restoration.

In my second year I also volunteered for another master's student I met at a film festival, where we talked about our passion for the environment. She later asked me to help her transcribe some interviews she had conducted with stakeholders in South Africa (fishers, locals, marine scientists and community workers) on the subject of marine protected areas (MPAs). The most interesting part was hearing the differences in opinion among the stakeholders and how the MPAs had affected their lives. They themselves had a very clear understanding of the need for the MPAs for increasing fish stocks, but there was little enforcement by officials.

These outdoor projects have taught me to be resilient, to get up and go out despite the weather and to adapt my methods to accommodate the conditions. In the winter months these projects have encouraged me to spend more time in nature, which has improved my levels of concentration and motivation with my studies as well as greatly improving my mental health and energy levels.

WHERE IS MY DEGREE LEADING ME?

My degree is equipping me with the knowledge to make change, to spread awareness and formulate arguments that have impact. Through reading journal articles I am developing the ability to separate reliable and objective writing from inaccurate and unreliable writing. I no longer accept everything at face value, which is essential in an age of fake news and mass media.

A degree in wildlife ecology and conservation science has led me to see that ecosystems are complex, fragile and in need of robust policies to protect them. I am learning the skills and methodologies that will allow me to not only contribute towards physical conservation progress but also to design research projects that will produce impactful results that can be used to protect habitats at risk and communities at the forefront of climate change. My degree is creating a deep sense of awareness and compassion for life beyond the human. It is also encouraging me to think critically about government policies and to recognise policies that do not put the environment, communities and ecosystems at the forefront of decisions.

Most recently, the skills I have developed through my degree have enabled me to begin a placement year at Kew Gardens as a student intern researcher, an opportunity that I would not have had without my degree.

OPINION

▲ **Figure 1. The course used for earthquake sessions at Stubbington Study Centre is pictured above and right. (© George Bethell)**

A POSTGRADUATE PERSPECTIVE
HOW PLACEMENTS ADD VALUE TO YOUR DEGREE

There are many opportunities available to students undertaking a degree in the environmental sciences, one of these being an industrial placement year. A year in industry can allow students to develop tailored skills and gain real-world experience in a sector they would like to work in. Placements are also a great way of finding out if an industry and/or an organisation is somewhere you would like to work in the future. In the environmental sector, there are many placement opportunities – from environmental consultancy and GIS to wildlife conservation and environmental education, which is coincidentally where I (George Bethell) ended up.

A placement year as an educational ranger at Stubbington Study Centre in Hampshire gave me the opportunity to teach primary school children about the environment; I did this through group workshops on topics such as minibeasts, small mammals, pond life and fossils. The residential setting aimed to improve teamworking skills and develop resilience (this was the first time many had stayed away from home, so was a big stepping-stone in increasing their confidence and independence). During that year I built on the skills I learned at university, such as public speaking, teamwork and health and safety assessment, including dynamic risk assessment. The placement also taught me how to deal with slightly more unusual situations, such as children falling into ponds or education sessions being interrupted by a fox cub stealing the children's water bottles!

My placement was varied and meant that I developed skills in numerous ways. During my training, I shadowed other members of staff before starting to teach small groups with a staff member present to step in if needed. Eventually I taught larger school groups of around 30 students and I began to teach these sessions on my own. As the year progressed, I took on greater responsibilities and regularly spoke to around 100 students in the dining hall, which helped build my public-speaking ability.

Being an outdoor education centre, managing the risks the weather brings was always of great importance, most notably high winds. During earthquake sessions


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(an activity where children navigate the course pictured in **Figure 1** carrying equipment that could be used to rescue people in an earthquake) some of the higher obstacles needed to be removed from the course so that the children would not be blown off them when the wind was particularly strong. At the beginning of my placement year this decision was made by other team members, but as the year went on and my knowledge of the risks grew, I was able to discuss health and safety aspects with team members and decide how to manage the obstacles in unsettled conditions. The experiences and skills I developed have made me more employable and I continue to build on them in my current role at a science centre, which involves extensive visitor engagement and presentation to large groups.

IMPROVED EMPLOYABILITY

My degree course in physical geography allowed me to specialise in ecology and conservation modules, which were directly relevant during my placement year and role as a seasonal ranger at a zoo. Being able to show an employer that you already possess some subject-specific knowledge is beneficial, as you may require less training. For me, possessing a broad science knowledge base in topics such as climate change, river processes and ecology is beneficial in my current role at the science centre, because it enables me to have more in-depth conversations with visitors.

There are also computer programmes that students may use during their degree. Being confident with GIS is an important skill to have as it is something that is used by many field researchers. I became competent in the use of ArcGIS Pro, a programme that we used to model deforestation of the Amazon, wildfires in South Africa and future global warming due to climate change. I also used Flood Modeller to determine the future effects of various flood events in a local town. Having experience working with programmes like these through your degree can be advantageous when applying for jobs.

PROFESSIONAL DEVELOPMENT POST UNIVERSITY

It can be hard to know how to continue your development after university, but there are several simple ways. Join a professional organisation such as the IES and attend any talks and conferences on offer. Continue to build knowledge in your area of interest by reading the latest academic material and finding someone in your field to mentor you along your career path – this is something that I plan to do through the IES very soon.

Volunteering is a great way to broaden your skill set while benefiting your community or a cause you care about. You can volunteer with industry-relevant organisations or try something in a completely different area. While at university I engaged in geography-specific volunteering, carrying out fieldwork for the DRY (Drought Risk and You) project, which helped to build on my research and surveying skills. I currently volunteer as a scout leader to help me develop leadership, teamwork and communication skills. The skills you learn while volunteering will add to your employability prospects while showing your employer that you are willing to work and learn by engaging in extracurricular activities.

AREAS FOR IMPROVEMENT

Although an environmental science education can enhance your employability prospects, there are aspects that could be better.

Starting career talks and discussing the value of networking at the earliest opportunity is something that can only benefit students. By encouraging them to think about their futures, universities will be equipping them for the working world and improving their prospects. This is something that I felt could have been initiated earlier at my institution.

Placement years are highly sought after and have the potential to equip you with the skills and experience that employers look for when hiring graduates. It is therefore important to encourage as many students as possible to undertake placement years and provide them with additional support while on placement. In addition to this I believe it is important to follow a placement year up with two types of session: one that allows students to discuss the skills they acquired during their year in industry, another where they can talk to students who are thinking about applying for placements.

WHERE HAS MY DEGREE LED ME?

So where has an environmental science degree taken me? The communication, public-speaking and conservation skills I developed at university and on placement led me to a summer job working at Bristol Zoo, educating members of the public about conservation. Since then I have started working at We The Curious, a science and cultural venue in Bristol. Having conversations about science with visitors and presenting shows has only been possible thanks to the communication and public-speaking skills I now possess. My environmental science degree and the opportunities it gave me to develop skills through academic teaching and during a placement year have enabled me to pursue a career I am passionate about: science communication.

Environmental education can often be neglected within the school curriculum, contributing to a disconnect between our society and the natural world. Instilling environmental values into students at a young age can greatly increase societal consideration for the environment, ultimately directing more young people to choose to study or work in an environmentally focused discipline. ES

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Building a career in a changing environment

Ethny Childs, Adam Donnan and **Pete Shaw** explore the career paths that can follow an environmental education.

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ANALYSIS

There are many reasons why people begin, sustain or dabble in an environmental education. For many, environmental science is an altruistic or ethical pursuit, fired by a sense of injustice and a desire to contribute to the reversal of environmental degradation. For others, it provides a chance to enjoy an academic extension of a passion they have for the natural world. But not all students start an environmental science education with a clear idea of the career they wish to pursue, or even the types of careers available to them.

The environmental sector is extremely diverse, spanning disciplines, sectors and organisation types; and the definition of what makes an environmental or green job is fluid and ever-expanding. With the growth and diversification of the environmental sector, there is now a myriad of rewarding careers to be discovered. The four established routes towards research, policy, regulation or consultancy still exist, but numerous specialisms have opened up within them, and new career pathways into entrepreneurship, social enterprises, industry and design have emerged.

This article explores how education providers ensure graduates are equipped with the skills needed to build a career in the sector, and the career outcomes of those with an environmental education. It also examines how the environmental sector is changing and the implications this has for the workforce and education providers.

ARE GRADUATES PREPARED FOR EMPLOYMENT?

In economically turbulent times, employability is a major concern for prospective and current students. Ensuring graduates are equipped with the skills, knowledge, understanding and attributes that employers want is therefore a key ambition for education providers: they strive to align their curricula with employers' needs.

Employer panels have played a central role in the development of apprenticeships, T Levels and higher technical qualifications. Employer advisory boards are also common in higher and further education institutions. So employers now have a greater role in education than ever before.

"The skills that employers say they want are not necessarily the same as what students say they want or what graduates actually possess. General employability skills are often seen by employers as more important than subject specific knowledge. These include communication, IT, creativity and organisational and planning skills. In many cases the skills that employers want from graduates are not different from what they want from the wider workforce. Furthermore, the 'skills' employers say they are looking for in graduates are often attributes, such as honesty, integrity, work ethic and social skills. An HE [higher education] *qualification acts as an indication of these qualities; however, it is unclear whether this is because HE develops these attributes or simply recruits people who already possess them."*[1]

Clearly, what employers want varies between sectors and types of employer – there is no one-size-fits-all approach. The diversity and range of roles leads to diverse and broad needs amongst employers. It is also inevitable that some aspects of what employers look for will differ between the private and public sectors, for example, and the size of an organisation will elicit differing needs. This is a consideration when involving employers' representatives as influencers of curricula: their inclusion brings valuable insights to employers' needs, but with the caveat that these reflect the specific type of employer(s) represented and their associated perspective.

We should not, however, allow this to dissuade programme leaders from engaging employers as advisors. The established separation of graduate skills into so-called soft (generic) and discipline specific is instructive in this regard.[2] Ensuring that employers' needs for skills in communication, teamwork and problem-solving are met is easily achieved through curriculum design and is, indeed, served by the Quality Assurance Agency (QAA)'s subject benchmarks that specify the relevant learning outcomes. There is, of course, greater scope for variation in employers' needs of graduates with respect to discipline-specific skills. There is thus a general tendency for soft skills to be delivered via core or compulsory modules within degree courses, while subject-specific skills tend to be delivered via both core/compulsory and elective/optional modules.

A brief look at the wide range of subject-specific learning outcomes for environment-related qualifications in higher education will reveal a vast range of specialist skills and attributes that are, potentially, of differing value and relevance to subsections of the environment sector (see **Table 1**).

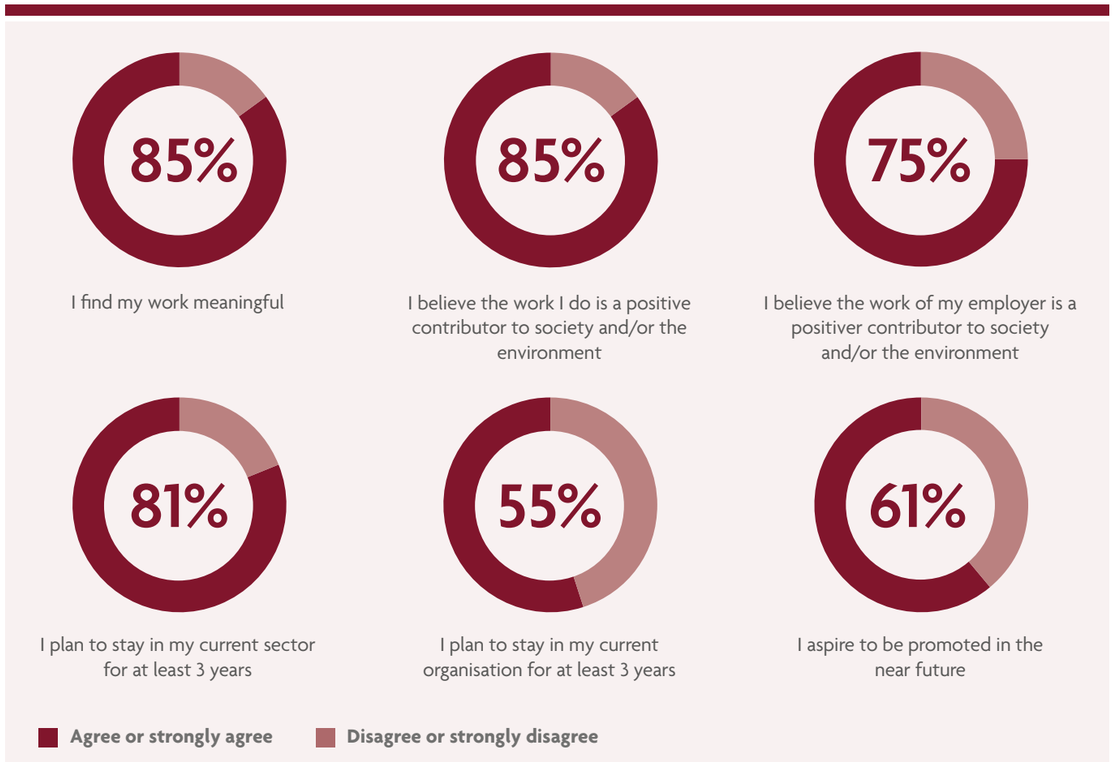
The current benchmark[3] was revised in part to increase emphasis on employability, and this change recognised the importance and prominence of employability in curriculum design. Indeed, the benchmark explicitly identifies the subject-specific applications of environmental studies and related degree courses, indicating key sectors to which such a qualification might lead:

- Environmental governance (e.g. non-governmental organisations, public policy and government);
- Environmental management (e.g. land, business and industry); and
- Environmental education and training (e.g. carbon literacy, education for sustainability, and development).

While this list is rather broad in nature, the inference is that curricula recognise – or should recognise – the alignment of learning with employers' needs and expectations, and that key areas for employment can be readily identified. We note that these three key sectors provide an appropriate guide for the constitution of employers' panels contributing to curriculum design.

▼ **Table 1. Examples of benchmark standards for environmentally focused degree courses and their relevance to employability[3]**

Benchmark standard cluster	Skill type	Example	Employability context of example benchmark standard
Intellectual skills (knowledge and understanding)	Subject specific	Knowledge and understanding of subject-specific theories, paradigms, concepts and principles.	Broadly relevant to a wide range of employers in the environmental sector; specific learning activities may influence the sector-specific relevance.
Practical skills	Subject specific	Undertake laboratory and fieldwork ethically and safely.	Of greater relevance and value to employers engaged in field and/or laboratory activities, such as regulatory monitoring and ecological consultancy.
Communication skills	Generic/soft	Good interpersonal communication skills to enable effective teamwork.	A must-have skill for all employment.
Personal and professional skills	Generic/soft	Display an appreciation of developing their graduate skills relevant to career pathways.	For all employers, an expected attribute; and for all graduates, an important attribute for career progression.



▲ **Figure 1. Responses about workplace satisfaction from a 2019 survey of IES professional members.[4]**

Whether and how an environmental science degree provides graduates with the attributes that employers value is of course critical, yet the available data are not specific enough to judge fully and in detail. Moreover, there is the question of whether and how an environmental science degree provides graduates with the opportunity to pursue a career in a field that is relevant to their ambitions.

CAREER OUTCOMES

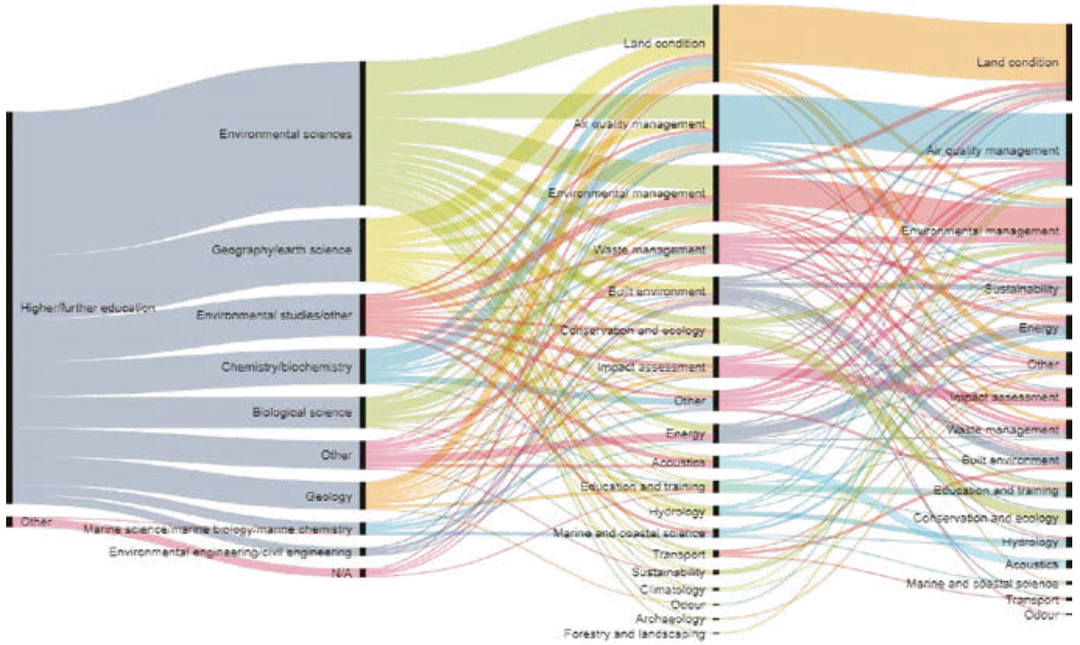
There is no clear dataset that can determine whether those with an environmental education achieve their career aspirations and whether people use their degree in an applied way. The motivations of individuals are difficult to track and people's views change with experience and rewrite memories to suggest a conscious choice that they did not make at the time.

In the absence of robust data, appraisal of career outcomes will have to be illustrative. Data from IES member surveys can be used to glean insights into how those with an environmental education have progressed in their careers and infer whether it does provide graduates with the skills needed to build a career in the sector.

Their professional membership consists of individuals working within the environmental sciences, so their surveys only capture those who chose to stay in environmental science, and not those who left the discipline, either straight after education or after a period of working in the sector. The *Salary and Workplace Satisfaction Report 2019* does, however, suggest a high level of workplace satisfaction:

- 85 per cent of respondents found their work meaningful;
- 85 per cent believed that the work they do makes a positive contribution to society and/or the environment; and
- 81 per cent said they plan to stay in their current sector for at least three years (see **Figure 1**).[4]

A recent IES career-mapping survey shows the respondents' journey from degree subject to current specialism (see **Figure 2**). This survey indicates the ability of those with an environmental education to enter a variety of different specialisms within the sector and the mobility of graduates between specialisms. This shows that an environmental education provides graduates with a holistic understanding of key environmental issues, and transferable skills and knowledge applicable to a range of roles.



▲ **Figure 2. Career paths of IES members from the career-mapping survey, from degree subject area to first job role specialism and then current job role specialism.**

Respondents were, however, self-selecting – only members who wanted to share their career story participated.

HOW MIGHT THE SECTOR BE CHANGING?

A variety of technical knowledge and skills are needed to fill the wide-ranging job roles in the environment sector. Changes in the job market determine the skills in high demand and these are dependent on the growth of the sector, mostly driven by legislative change, client demand and technological innovation. The diverse nature of the environmental sector and the lack of granularity in most workforce datasets means that there is no single data source that can give an overview. Instead, we can only build a partial picture from a range of data sources to determine how the sector has changed recently, and how it might change in the future.

The environmental goods and services sector in the UK showed a number of areas of growth and decline in the period 2008–2018, in terms of the number of full-time equivalent (FTE) job roles.[5]

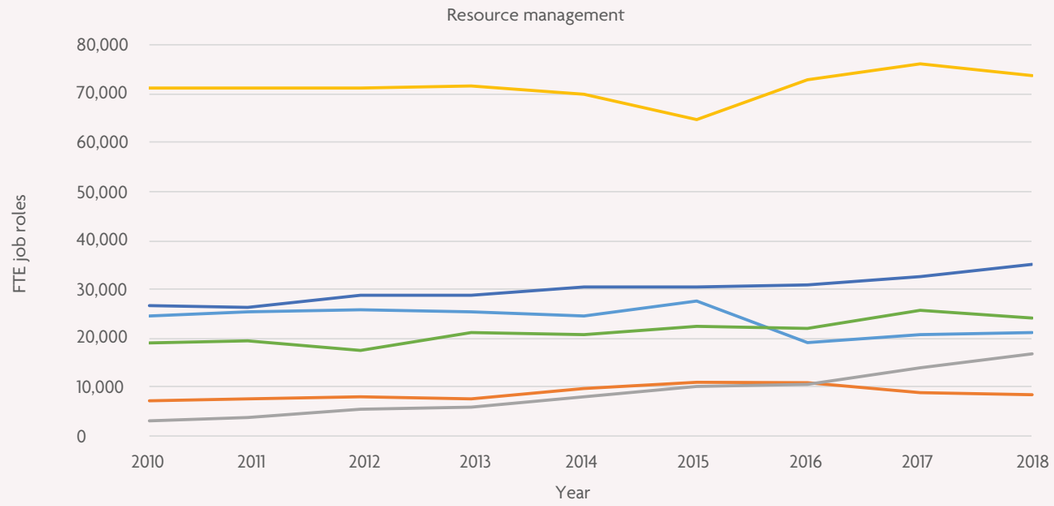
The trends shown in **Figure 3** represent the environmental job roles with the highest headcounts and how these have changed in the recent past; some of these trends may not carry into the future. For example, decreases in environmental protection roles may be reversed as a result of recent and upcoming legislative change, particularly in areas related to the protection of biodiversity and landscapes. Resource management roles will likely continue growing as renewable energy, food security and waste and water management continue to grow in importance as a result of population growth and climate pressure.

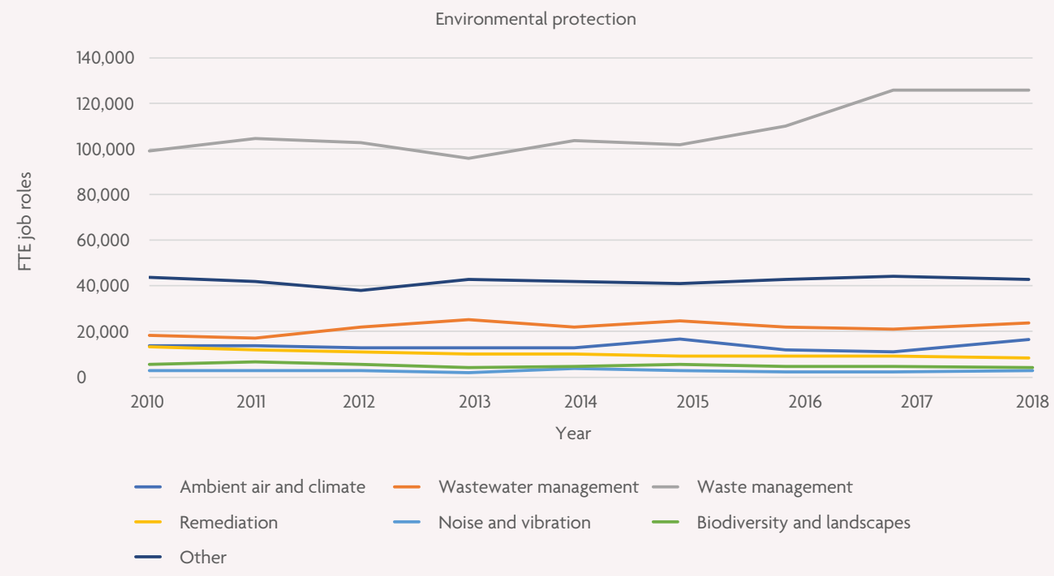
FUTURE CHANGES

The growth of the environmental sector is set to continue. The environmental consultancy sector alone is projected to break the £2 billion barrier by 2022, one year earlier than previously predicted (this date was estimated before the Covid-19 pandemic).[6] This is also despite a projected reduction in growth following the Brexit referendum. Although the market did see a slowdown in growth, the industry quickly rebounded and grew by 5 per cent between 2018 and 2019. Public spending in the sector also saw an 18 per cent boost in the same period.[6] This is pertinent because public spending currently makes up 22 per cent of all environmental consultancy spending,[6] and is likely to continue to increase because of the calls for a green recovery from Covid-19, a transition to a net-zero carbon economy, and major nationally significant infrastructure projects (such as HS2 and Highway England's road investment strategy).

There are recent and forthcoming legislative changes that are likely to impact public spending in the sector and subsequently impact the environmental workforce (see **Table 2**).

Changes in the number of full-time equivalent (FTE) job roles in environmental protection and resource management from 2010 to 2018





▲ **Figure 3. There has been an increase in the number of FTE job roles in many environmental specialisms.[5] (Note: some data points for 2018 are provisional.)**

▼ **Table 2. Current and upcoming legislative changes in the UK and potential implications for the environmental workforce**

Legislative change	Key points	Potential implications
Environment Bill[7]	• Creation of Office for Environmental Protection; • Biodiversity net gain requirement; and • Target setting for air quality, biodiversity, water, resource efficiency and waste management.	• Growth in biodiversity and ecology specialisation; and • Target implications will depend on how ambitious the targets are and whether they will make use of existing data or will require new monitoring schemes. Potential increases in jobs, in these areas.
Climate Change Act 2008 (2050 target amendment) Order 2019[8]	• 100 per cent reduction of greenhouse gas emissions by 2050.	• Focus on decarbonisation of transport; • Growth in jobs in the renewable energy and low-carbon sectors; • Changes to air quality management roles and focus; and • Increase in sustainability roles.
Agriculture Bill[9]	• Public money for public goods.	• Growth in land/catchment area specialists; and • Growth in soil-health and food-security specialists.
Planning for the Future white paper[10] and upcoming consultation on environmental impact assessment (EIA)[11]	• Streamlining of planning process using zones; and • Simplifying the EIA process.	• Digitisation of EIAs – different skills focus; • Reduction in EIA specialists; and • Reframing of consultancy work in this area – transition to value-based contracts with clients?
International commitments	• Paris Agreement – nationally determined contributions (NDCs); • 2021 United Nations Climate Change Conference (COP26); and • Convention on Biological Diversity.	• International commitments will continue to influence policy decisions at a national level; and • Protection of biodiversity, clean energy, clean transport, nature-based solutions, adaptation and resilience will be key areas.

The complexity and integrated nature of many of the key challenges that upcoming legislation is aiming to address highlight the need for future environmental professionals to be equipped with interdisciplinary skills and knowledge. Fostering holistic and systems-level thinking in environmental science students will be absolutely key, as well as updating course materials to include the development of sought-after knowledge (e.g. the circular economy and natural capital approaches) and skills (e.g. environmental modelling and digital literacy). Big data and machine learning will play an increasingly large role in all sectors, and aspiring environmental scientists equipped with these skills will have a competitive advantage with regard to employability. The ability to distil complex scientific ideas into easily understandable messages for a range of different audiences will also be a key requisite for environmental science graduates entering the workforce.

The government's commitment to achieving a net-zero carbon economy by 2050 will have major implications for environmental professionals and will result in significant job creation.[8] As we begin this transition, the environmental sector will become more closely integrated with all other sectors and industries. How an environmental professional is defined is likely to evolve and expand, and environmental scientists will be working with an even more diverse range of organisations and people, reinforcing the need for strong science communication skills.

To deliver the government's environmental objectives in this area, the workforce needs to be equipped with the right skills, so that supply meets demand. This will require a new suite of skills, many of which will need to be cross-sectoral. Indeed, the Aldersgate Group has called for the government to make low-carbon skills provision a national policy priority to reduce the current skills deficit in this area; embedding low-carbon and sustainability skills throughout the curriculum at all levels of education is one of the key recommendations for the government to achieve this.[12]

ADDRESSING SKILL GAPS

Policy-makers, educational institutions and professional bodies will all have important roles to play in addressing current skill gaps and equipping the environmental professionals of the future with the right skills to meet the needs of employers. Professional bodies should focus on fostering interdisciplinary skills in the workforce through collaboration with other bodies. This could include the development of a post-tertiary education 'skills passport', which would support skills transferability through common standards and accreditation. This would complement 'employability passports' used by a number of educational institutions. Education providers should continue to involve employers in the development of curricula so that emerging demands for skills and knowledge are reflected in course materials.

All this will ensure that environmental science graduates continue to be highly sought after in the workforce due to their complementary skill set and holistic understanding of environmental processes. This will, in turn, secure a resilient environmental workforce able to tackle current and future environmental challenges. ES

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FEATURE

The value of inclusion in environmental science

Piers Wilkinson highlights the need for a shift in our mindsets.

As the education and environmental science sectors respond to the shifting demands of a global pandemic, the majority of our professional and personal lives have moved online. Considering the role that disabled people have played in enabling the sector to shift so rapidly to digitising and remote working requires us to recognise the value of inclusion – both for disabled people individually and as a strategic approach to working smarter and not harder.

Alongside a global pandemic and the implementation of blended learning, this September marked the passing of one of the major deadlines for the Public Sector Bodies (Websites and Mobile Applications) Accessibility Regulations 2018 (PSBAR).[1] The result is the current challenge facing our education institutions and wider sector: to shift our ways of working to comply with these new standards for websites and content. Compliance, however, is not known as the driver for change within any sector. Instead the main drivers are the integration and appreciation of good practice as core teaching and methodological approaches.

Often when discussing disabled students or inclusive practices, the definitions, history and principles underlying them are often assumed to be common knowledge, but that is not the case for many.

FEATURE

THE SOCIAL MODEL AND INCLUSIVE EDUCATION

The definition of disability is, unsurprisingly, not static and as with any definition undergoes revision and redefining as progress is made. However, as this is not a disability studies journal, I can probably get away with stating that the current go-to definitions of disability in the UK can be split between two main models: the medical model and the social model.

A significant proportion of the UK still considers disability within the medical model, and that is not too surprising when one considers that, in England at least, it can be traced back to at least the early 18th century. The medical model determines disability by an absence of capacity or ability, with limitless variations. This absence of capacity or ability is part of the core criticism of this model by disabled people. Not only does it place the causal issues with the individual, it codifies the barrier that an individual faces as a personal failing or limitation.

The social model, which can be traced back to the 1960s, is the one currently championed by disabled people and is part of the Equality Act 2010. The social definition of disability is generally attributed to the *Fundamental Principles of Disability* by the Union of the Physically Impaired Against Segregation (UPIAS): 'Disability is something imposed on top of our impairments, by the way we are unnecessarily isolated and excluded from full participation in society'.[3]

Essentially, the social model identifies that while individuals may have an impairment, it is the absence of inclusive design that creates barriers for them. The most frequently used example is that while a wheelchair user may have a physical impairment, it is the lack of lifts and level access that denies them entry to a building – the initial design of the building failed to consider the diversity of future users. Inclusive design (the incorporation of the social model of disability into design and strategic planning) minimises the need for special adaption or specialist individual support. With environmental science being a comparatively fieldwork-heavy sector, everyone working in it can appreciate the benefits that level access and lifts provide when they are carrying equipment and field samples.

INCLUSIVE EDUCATION

What 'inclusive education' definitively means is still an area of great discussion for disability studies scholars, and even disabled people within the disabled peoples' movement. As with any topic, different institutions and individuals across the world take a different approach to inclusion, with a mystifying myriad of policies and definitions. The UK, while considered to do reasonably well in terms of social inclusion, took almost 30 years to officially recognise that disabled people prefer the social model of disability. A simplified definition can be the integration of inclusive design into education – designing education to be accessible to as many people as possible without the need for special adaption or reasonable adjustments.

THE SOCIAL VALUE OF INCLUSION

The moral argument for implementing accessible and inclusive education, while important, is not really necessary. Ensuring environmental science operates in an inclusive way is paramount to ensuring widespread engagement and a sustainable future for the sector – and not just because disabled people make up at least 20 per cent of the population. The variable format approach of inclusive education that enables disabled people with different impairments to access content inherently supports the myriad of different engagement styles across the whole population. With the evident success of science podcasts such as BBC Radio 4's *The Infinite Monkey Cage* highlighting the growing engagement with, and demand for, audio formats, being able to listen to a research paper or journal article is as beneficial to a visually impaired person as it is to an auditory learner. Regardless of whether you are a researcher, lecturer, activist or student, producing accessible and inclusive content is an essential skill. It also is not as hard as the design consultants will lead you to believe! There is a plethora of freely available online resources curated by specialists in the fields of digital accessibility, education and inclusion.[4]

Given the rapid shift to online learning and digital working, it is particularly apt that the successes achieved from developing assistive technology for use by disabled people is recognised. While assistive technology started off as a niche market, it has seen unprecedented uptake in recent years. Subtitles and captions on videos as an engagement strategy have become widespread since the discovery of user practices on social media, along with the integration of speech-to-text or speech control in everyday devices (Siri, Cortana, Google Home) and text-to-speech use for satnav.

Some aspects of the shift to digital provision in education as a result of Covid-19 have come as a bittersweet success for the disabled student movement, which has been campaigning collectively for more than a decade for changes such as lecture capture as a core provision. Other types of provision, such as the use of virtual reality to facilitate field-trip experiences for students, have the potential to radically change how disabled

▲ **Assistive technology, such as a braille display attached to a computer or mobile device (as shown in the above image), can be essential in supporting individuals in navigating some of the barriers in education, for example, note taking in lectures. (© elypse | Adobe Stock)**

students with a mobility impairment experience environmental sciences in the future – no longer will salt marshes be known as the eaters of wheelchairs.

THE ECONOMIC ARGUMENT FOR INCLUSION

Who? Diversity and Ability (D&A) is a disabled-led social enterprise that supports students, organisations and social justice projects to create inclusive cultures. D&A aims to help people and organisations achieve positive culture shifts, so that disability inclusion and accessibility are woven into the fabric of educational and workplace environments – from one-to-one assistive technology training and mentoring to group workshops and leadership coaching.

What? D&A primarily supports disabled people in education and work, such as students in receipt of Disabled Students' Allowance (DSA) and disabled people who receive support from Access to Work. It also provides various consultancy services.

Why? D&A champions the principle that learning differences arise from natural human diversity, as opposed to the 'deficit' models of understanding disability. The principle celebrates different learning styles and the important contributions neurodiversity make to society.

The result? UnLtd, the foundation for social entrepreneurs, and the New Economics Foundation conducted a cost–benefit analysis on outreach in higher education. It showed that for every £1 spent on D&A support services, a return of £16.55 of social value is created.[5]

BOX 1. EXISTING BARRIERS

It would be a disservice to current students to not mention the current barriers that disabled students face in education. While there has been a lot of progress in inclusion over the last couple of decades, there are still persistent and systemic barriers to accessibility and inclusive education.

Instead of a listicle of issues currently experienced by disabled students, I would like to refer readers to the recent publication of *Arriving at Thriving*,[7] which centres on the experiences of disabled students in higher education and proposes 12 recommendations for the sector. The inquiry engaged disabled students from the outset, championing their voices throughout the entire process. The resulting report is lauded by many disabled students across the country as an accurate summary of their experiences.

A LIFETIME OF SKILLS

It is no secret that our society is not fully accessible for disabled people (see **Box 1**), but until we achieve systemic equitable access, there is a hidden advantage – disabled people have one of the greatest socially nurtured skill sets for the environmental sciences. Common core skills for environmental sciences include:

- Observation skills and critical thinking;
- Innovative thinking;
- Investigative and research skills;
- Problem solving; and
- Navigating complex bureaucratic funding systems.

Disabled students are often faced with many hours of additional administrative and bureaucratic work each week just to access their reasonable adjustments[6] – be that DSA, Access to Work, institutional procedures or social care. Any disabled person can attest to needing the skills listed above just to maintain daily life. Often these essential skills are required for activities non-disabled people barely consider, from joining friends and colleagues at the pub or organising passenger assistance to be able to get a train home. One could even suggest that a disabled student might find it easier to write a multi-million-pound research proposal than to set up the military-grade operations strategy necessary to figure out if they could attend their sibling's wedding.

Additionally, many students are awarded a sentence or two on their degree transcript for each item of extra-curricular work they do while studying, be that organising guest lectures or beach clean-ups. Yet many disabled students cannot participate in the extracurricular activities that are recognised on the transcript, but the essential skills and experience acquired navigating the plethora of support systems required to study environmental sciences are not recognised. The environmental sector recognising the additional skills and value of disabled people, staff or students could be a first step towards addressing the disparity in outcomes for disabled people.

MORE PROGRESS NEEDED

While the co-produced principles and philosophies of inclusion for disabled people have been known for a while now, with some remarkable advances in recent years, there still remains a structural resistance to integrating disabled people's access into core working practices. Yet there is a multitude of social, economic and academic benefits to be enjoyed by all if both the environmental science and education sectors were to adopt inclusive design as an integral way of working. Each could greatly benefit from the unique insight and problem-solving skills of disabled people: non-disabled people in the sectors could greatly benefit from the software, technology and productivity from assistive technology, and finally disabled people would enjoy a more inclusive experience. ES

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ANALYSIS

Achieving lifelong eco-literacy through adult environmental education

Philip Turvil explains what would be required to enable a wide cross-section of adults to play their part in defending the natural world.

The environment is in crisis and people want to help. But they need accessible education to understand and protect the biodiversity on which nature and society depends. The solution is environmental education for adults, including younger and more diverse people, that gives them accessible and personalised learning pathways. In this way, we achieve practical eco-literacy.

LET'S START WITH 'WHY'

The UK government's 25-year environment plan[1] amply describes our environmental challenges and urgency to improve. Most notably, goal three seeks to recover threatened, iconic and economically important species of animals, plants and fungi; goal six seeks to enhance engagement and action from all sectors of society.

The UK's biodiversity action plans also set out a number of priority species and habitats that are threatened and require conservation action, and the annual State of Nature reports[2] show severe data deficiency in many species groups due to lack of biological records. The challenge is skill shortages: the skills to correctly identify and monitor plant, fungi and animal species underpin every environmental project focused on conservation and restoration. Every project needs biodiversity baselines and indicators of change. Despite this need, there are fragmented learning pathways, low tutor recruitment and

◀ **Training courses provided by the FSC's BioLinks project have taught thousands of adults to identify and record invertebrates. (© Keiron Derek Brown)**

few resources in natural history societies,[3] according to extensive consultation by the Field Studies Council (FSC), a leading provider of biodiversity education for adults.

The Chartered Institute of Ecology and Environmental Management (CIEEM) also reports wide-ranging skill shortages amongst volunteers and professionals, especially in ecological surveying, sampling, data assessment, evaluation and monitoring.[4]

Given the UK government's latest investments in job creation and retention schemes to help manage the impacts of Covid-19, redressing skill shortages is an opportunity not to be missed. Major grant funders (such as the National Lottery) are also investing to support jobs. Environmental education offers adults signposting to, and support to obtain, roles in the green economy, such as species recorders and habitat managers. But while data-deficient species and green roles are priorities, the roadmap requires a pipeline that starts with people progressing through introductory skills.

BUILDING A PIPELINE

From a standing start, adult education needs to connect people with natural environments, in ways that could be as simple as spotting five leaf shapes on the way to work or creating a diary of local mushrooms. This connection increases the number of people who have awareness of and interest in the natural world, and enables them to progress through levels of knowledge and motivation to stand up for the rights of threatened species. Over a lifetime, people develop attitudes and seek opportunities to support nature recovery through personal habits or by joining the green economy in volunteer and professional roles. Imagine, for example, more people sharing their favourite *Quercus* species or describing the nocturnal habits of gastropods. Or volunteering to study data-deficient fungi species and changing career by retraining as an environmental scientist.

Ultimately, a pipeline means more people understanding and protecting natural environments. Passive interest turns into action-taking behaviour. The result is more enthusiasts and biological records, and therefore a high profile and better reference points on which to base conservation decisions. All of this starts with teaching.

STEPPED TEACHING

The goal of adult environmental education is practical eco-literacy. This means more adults joining accessible learning pathways that lead to practical actions, rather

than feeling intimidated by biodiversity or helpless to act in the fight against climate change. Good teaching builds up knowledge, skills, confidence and motivation for people to engage in ways that suit their ability and ambitions. Some will even go on to become experts who fill gaps within key species groups and teach others.

Successful teaching creates a widely accessible and relevant portfolio of learning experiences that deliver lasting impact for people and the environment. The FSC, for example, is using this approach to transform hundreds of biodiversity training courses it delivers annually to adults. It is working in cycles of development, delivery and evaluation with a team that blends skills in teaching, taxonomy and marketing.

The FSC approach starts with the co-design of a learning framework for specific biodiversity subjects – ferns, for example. The process is driven by discussions with target audiences, expert tutors and specialist societies. The goal is an informed understanding of needs and the practical application of new knowhow.

These learning frameworks split a biodiversity subject into smaller topics, and each topic achieves a learning outcome tailored to a competence level and the adult's reason for learning the skills required to record the main lichen species in a coastal town, for example. Once there is a learning framework:

- The FSC sequences topics together to create courses delivered through online and place-based learning, in short and long form, including assessment and recognition of achievements; and

- Adults sequence courses together to create personalised learning pathways. These give learners ownership of their unique pathway as they choose the format, level and progression through and between different environmental subjects.

The FSC's BioLinks project has taught thousands of adults to identify and record invertebrates using a similar approach to learning frameworks. So far there have been hundreds of new environmental volunteers and thousands of new biological records, thanks to courses delivered credibly and consistently with engaged partners and trained tutors.

The challenge to stepped teaching is a sustainable funding model. In the above example, the FSC blends course fee income with philanthropic grants to develop


© Joshua Resnick | Adobe Stock

and deliver adult education courses for popular and niche subjects. But more funding is needed to invest in learning frameworks, new tutors, under-resourced societies and marketing.

DIVERSIFYING ADULT EDUCATION

The UK government's landscapes review states: 'a lot more must be done to meet the needs of our many fellow citizens who do not know the countryside, or do not always feel welcome in it, but should be able to enjoy it'.[6] There is a lack of diversity in the adults attending courses, which is reducing reach, impact and sustainable funding for education. Environmental professionals are part of the least diverse occupation in the UK,[5] second only to farmers. People from black and minority ethnic communities are severely underrepresented. There are also too few younger adults on training courses, despite many surveys and projects demonstrating high interest.

So the future of adult environment education must involve far more people who are younger, from black and minority ethnic communities, and previously unengaged with practical eco-literacy. With this, we will diversify public engagement beyond the engaged, older, white people who more commonly access environmental education. The challenge is investing in compelling storytelling shared through credible influencers and other marketing channels, in local communities a nd online. The stakes are high and urgent if the natural environment is to be protected by a cross-section of society.

ENVIRONMENTALLY EDUCATED ADULTS

Successful adult training courses and experiences can enable practical eco-literacy for more people from more backgrounds. The impact will be that our communities will have more people able and willing to stand up for the rights of threatened species and to support habitat restoration. Without this, we will lose momentum from social movements, and fail to capitalise on nature's newfound appreciation during the Covid-19 lockdown. This is a unique moment in time for adult environmental education and one that needs action now. ES

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The Field Studies Council is an environmental education charity in the UK that is committed to helping people connect with nature, learn about it and make choices to help protect it. It runs 400 adult learning courses annually, and in 2019, hosted more than 150,000 people of all ages in 20 field centres through day and residential training courses and experiences. The FSC is also the UK's leading producer of wildlife fold-out ID charts and books for beginners and experts. It distributes more than 140,000 vocational biodiversity publications annually.

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OPINION

How to educate for an environmentally resilient economy

Serena Murdoch, Henry Webb and **Jude Daniel Smith** summarise the changes that are needed across the whole education system.

Our education system is no longer fit for purpose. Covid-19 has brought many obvious flaws into the limelight that we have ignored for too long – from the blatant inequality of opportunity to the recent results fiasco. It is clearly time to rebuild our education system, alongside the rest of the economy after the pandemic, for the 21st century. In our experience, as youth activists and students living in the UK, the majority of teaching and learning in the education system is not aligned with the scale of the climate crisis and the changes urgently required to equip our generation to ensure a sustainable world.

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MINIMAL, SILOED TEACHING

Students go through years and sometimes decades of teaching, and all these years have the potential to be a tremendous force for social and environmental change. However, our schools, colleges and universities severely lack comprehensive climate education. We are led to believe that sustainability and the protection of our planet's existence are niche subjects, not concepts that are fundamental to everything we learn and do. Topics are siloed into separate classes, such as geography or chemistry, and dealt with only at a basic level and only in secondary education. The already minimal amount of knowledge about the climate emergency is restricted to subjects seen as 'relevant' to our changing climate.

A revamped education system is essential to the implementation of a green recovery following this pandemic, which is a short-term crisis within a much greater one: the beginnings of the climate and ecological breakdowns. These breakdowns will require an economic transition – in terms of scale and speed, unlike any seen before. In just a decade, millions of jobs in oil and gas, aviation and thousands of other sectors will, of necessity, be lost. If mishandled, the result could be disastrous, historic unemployment.

However, as some industries fall, others will rise, creating new employment opportunities. This article aims to highlight what those sectors are, how we can grow them sustainably, and ways that education can bridge the gap between our current economy and a new, sustainable one.

A RESILIENT ECONOMY

The technology needed for a zero-carbon economy exists, yet relative to what is necessary, we have implemented almost nothing. In 2017, it was estimated that 85 per cent of the jobs students would be doing in 2030 do not exist yet.[1] The climate is changing rapidly, and our economies, communities and societies are following suit. The education system must reflect and prepare the workforce for this fast-paced change, but what does a resilient green economy look like? Decarbonisation, resource efficiency, equity and protection of the vulnerable are necessities; the UN Environment Programme defines it as 'low carbon, resource-efficient and socially inclusive'.[2]

"The technology needed for a zero-carbon economy exists, yet relative to what is necessary, we have implemented almost nothing."

Innovation and demand have led to sectors becoming more environmentally sustainable. From green roof gardens to vertical farming, global agriculture has started to adapt to urbanisation, desertification, lack of space and issues of unequal distribution. Employment in green building, green design and clean energy has also been on the rise, fuelled by the natural scientists

▲ **Teach the Future volunteers gather outside the UK Parliament ahead of their parliamentary reception in February 2020. (© Teach the Future)**

▲ **Scarlett Westbrook, a campaign coordinator for Teach the Future, speaking at the Teach the Future parliamentary reception in London in February 2020. (© Teach the Future)**

whose research makes these sectors possible. In 2017, it was estimated that there would be 24 million jobs globally in the renewable energy sector by 2030 (an increase from 11 million in 2019)[3,4]

Mitigation and adaptation efforts relating to the climate and ecological crises will have to be woven through all of our existing sectors, while novel employment areas develop simultaneously. Employment rates improve, albeit marginally, with increased climate policy.[5] The transition to a greener, more resilient economy can be eased by retraining the workforce and educating students now, allowing for increased innovation and improvements in technology. We can ensure this is done fairly, closing existing discriminatory development gaps, with the necessary expenditure and investment.

As we start to see the light at the end of the Covid-19 tunnel, further fiscal stimuli will be necessary. Why not prepare for the climate crisis concurrently? Transitioning the people recently unemployed due to the pandemic, who are also the most socially vulnerable, into resilient jobs is an opportunity not to be missed. Regions and states have already started to seize this chance: in July 2020, South Korea announced its Green New Deal (also known as the Korean New Deal) as part of an economic recovery plan. It aims to create 659,000 jobs with an investment of 73.4 trillion won, focusing on green infrastructure, low-carbon energy and greener industry.[6]

By teaching sustainability and climate resilience across a national syllabus, green jobs will become more equitably distributed and more abundant as carbon literacy increases. Through climate education, all areas of the economy, not just the obvious ones, will be rethought and redesigned to adjust for the climate crisis.

WHAT EDUCATION NEEDS TO PROVIDE

Education can easily bridge the gap between the climate emergency and the economy necessary to abate it. However, there are a few barriers to this.

The first of these is the skills gap. Perhaps it does not need to be said, but we need to end training for new jobs in industries that are reliant on fossil fuels. The engineers and scientists, economists and architects – the workforce of the future – will need to be trained to build that future. Every university, college, school and apprenticeship scheme must focus on the skills necessary to overhaul our infrastructure, from transport to food to housing.

The energy industry employs almost 30 million people worldwide in fossil fuels,[7] and all of them are going to need new jobs, as are the millions of others in industries dependent on those fuels. All of them will need retraining. While many skills will be transferable, and much of this retraining will be done by new employers, the transition will still place significant pressure on the world's educational institutions.

Yet there has arguably never been a better time, as universities and colleges adapt to teaching online, for a revolution in education. Pre-recorded content will never be a genuine replacement for in-person teaching, but a hybrid approach could offer more flexibility and allow for the higher capacities necessary. If we are going to retrain an entire workforce in the space of a decade, the conventional delivery of education merits consideration.

Where does this leave primary and secondary education, or sectors that will largely remain the same? These will also ultimately need reformation. Climate education must be integrated into every subject, producing students who

▲ **Teach the Future volunteers at a youth strike focused on climate education in London in 2019. (© Mark Edwards/Hard Rain project)**

understand our impact on the natural world as well as how we can reduce that impact.

This leads to the second issue: most people do not understand the reality of climate and ecological breakdown, or the scale of what is needed to stop it. This gap in the perceived threat we are facing is a fundamental flaw of the education system: it is no longer enough to consider climate change only briefly in optional subjects. Students must learn about the real impacts climate breakdown is having on communities right now. They must be taught about the 100 companies responsible for more than two-thirds of world emissions,[8] and the disproportionate historical contributions of North American and European economies to this global problem.

A green new deal, one grounded in the principles of climate justice and that leaves no one behind, is possible, and it needs to start with education.

SOME SOLUTIONS TO ENVIRONMENTAL ISSUES

Just 4 per cent of students 'feel that they know a lot about climate change' and 75 per cent of teachers 'feel they haven't received adequate training to educate students about climate change' in the UK.[9] If students are not being taught about this global crisis, how can they be expected to fill the future green workforce? Teach the Future is a campaign led by students to repurpose the UK education system around the climate and ecological breakdown. They believe that to do this, increased vocational training, teacher training and a revamped national syllabus is necessary. For example, as a form of green recovery, government investment in retrofitting schools would spread employment across the nations, save carbon emissions and prepare schools and students for climate change.

Another example of environmental education playing a part in the creation of green jobs comes in the form of gender equality. In Guyana, the Mangrove Restoration Project (GMRP) aims to cultivate mangroves to increase resilience to storm surges, rising sea levels and flooding. Part of the program is training for women on subjects such as climate change and the role of mangroves, along with propagation and project management for their restoration. The project planted 460,000 mangrove seedlings between 2010 and 2013 and created a sustainable income for more than 50 women in the region.[10] This is an example of increased equality, green employment and ecological resilience leading to decreased vulnerability.

Climate education can (and hopefully will) be used as the most efficient tool for breaking down social inequalities resulting from or worsened by the ecological crisis. The right education can create sustainable industries and greener jobs to strengthen economies around the world weakened by Covid-19, while also providing more and more solutions for the most critical emergency humanity has ever faced. ES

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