

The potential of the Earth Charter as a science-teaching tool

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ABSTRACT Current UK policy is that all schools should be sustainable by 2020. The teaching of science and the scientific approach is fundamental in changing society, its outlook and practices with regard to sustainability. The Earth Charter, a statement of intent for humanity, can be a useful vehicle for developing the sustainability agenda in science departments and schools, while allowing for the incorporation and development of higher order thinking skills such as analysis, evaluation, creativity and empathy, all with a global appreciation. These vitally important transferable skills are key to producing sustainability-aware scientists and citizens of the future. The article uses the English curriculum and two Charter principles for illustration, but has wider implications.

The UK Coalition Government of 2010 has yet to publish its policy on ‘sustainable schools’ but the coalition agreement (HM Government, 2010) incorporates the word ‘sustainable’ in reference to banking, finance, planning, food production, transport and other areas, so it is clear that the concept remains central and that schools will be expected to play their part. The previous government had the aspiration that all schools should be sustainable by 2020 (DfES, 2006a), and a recent Ofsted report (2009: 4), based on random visits to 14 schools, suggests that after a slow start there is evidence that progress is being made.

When we consider the needs of the planet and future generations, the importance of ‘sustainable development’ is clear, especially as defined by the former Department for Education and Skills:

... inspiring people in all parts of the world to find solutions that improve their quality of life without storing up problems for the future, or impacting unfairly on other people’s lives. It must be much more than recycling bottles or giving money to charity. It is about thinking and working in a profoundly different way. (DfES, 2006b: 6)

‘Thinking and working in a profoundly different way’ goes considerably further than the *Sustainable schools* strategy document (DfES, 2006c), which identified eight instrumental ‘doorways’ towards sustainability in the curriculum, campus and community. These are:

food and drink, energy and water, travel and traffic, purchasing and waste, buildings and grounds, inclusion and participation, local well-being and global dimension.

The development can be seen by comparing these specifics with the criteria used by Ofsted to assess an outstanding school:

The school has embedded learning about sustainability within the curriculum and life of the school and is working with the community to advance a whole-school approach to sustainability. Parents and governors are important partners in this process. There is a coherent and systematic programme of continuing professional development which supports the development of sustainability and includes opportunities for feedback on current issues. Staff are working as a team to implement commonly agreed aims and objectives. The school monitors and reviews physical, procedural and attitudinal changes and adjusts its plans accordingly. Effective use is made of the wider school, local environment and neighbourhood community to foster an active involvement in practising the principles of sustainability. Students play an integral and often leading part in this process. There is a clear understanding of the issues raised at both local and global level. Approaches to teaching and learning actively promote the development of environmentally and socially responsible

values and behaviour. There is a high degree of consistency between the school ethos and the values which underpin sustainability. As a result of participating in democratic processes within the school and the locality, students frequently take the lead in creating the impetus for sustainable change. There is a policy which achieves high rates for reduced consumption, re-use and recycling of resources. Water and energy conservation is taken fully into account in school planning and development. There is a purchasing policy with criteria which take into account cost versus impact on the environment, sustainability and fair trade. Students take informed action at home and in the community. (Ofsted, 2009: 28)

This article suggests that one way to achieve coherent excellence of this kind may be to incorporate the overarching ethical and inspirational framework of the Earth Charter (2000) – a declaration of principles for a just, sustainable and peaceful global society – and that this can, in particular, ensure that science teaching is able to take its essential place as part of a whole-school approach.

The Earth Charter – some background

The Earth Charter was drafted in a worldwide process of consultation involving thousands of individuals and hundreds of organisations, following a call from the UN General Assembly at the 1992 Rio Earth Summit. It aims to provide for all people, nations, corporations and civil society a set of 16 principles and 61 sub-principles for a just, sustainable and peaceful global society. These principles are grouped under four headings (sometimes referred to as ‘pillars’ or ‘foundations’):

- Respect and care for the community of life;
- Ecological integrity;
- Social and economic justice;
- Democracy, non-violence and peace.

As well as the 16 principles (Box 1), the preamble and the conclusion (*‘The way forward’*) of the Charter are central and provide a scientific and philosophical perspective.

The use of the Charter during the Decade for Education for Sustainable Development (2005–2014) was recommended by UNESCO in 2003, when it adopted a resolution recognising the Earth Charter *‘as an important ethical framework for sustainable development’*. UNESCO has also published a handbook on *Good practices in education for sustainable development using the*

BOX 1 The 16 principles of the Earth Charter

Respect and care for the community of life

- 1 Respect Earth and life in all its diversity.
- 2 Care for the community of life with understanding, compassion, and love.
- 3 Build democratic societies that are just, participatory, sustainable, and peaceful.
- 4 Secure Earth’s bounty and beauty for present and future generations.

Ecological integrity

- 5 Protect and restore the integrity of Earth’s ecological systems, with special concern for biological diversity and the natural processes that sustain life.
- 6 Prevent harm as the best method of environmental protection and, when knowledge is limited, apply a precautionary approach.
- 7 Adopt patterns of production, consumption, and reproduction that safeguard Earth’s regenerative capacities, human rights, and community well-being.
- 8 Advance the study of ecological sustainability and promote the open exchange and wide application of the knowledge acquired.

Social and economic justice

- 9 Eradicate poverty as an ethical, social, and environmental imperative.
- 10 Ensure that economic activities and institutions at all levels promote human development in an equitable and sustainable manner.
- 11 Affirm gender equality and equity as prerequisites to sustainable development and ensure universal access to education, health care, and economic opportunity.
- 12 Uphold the right of all, without discrimination, to a natural and social environment supportive of human dignity, bodily health, and spiritual well-being, with special attention to the rights of indigenous peoples and minorities.

Democracy, non-violence and peace

- 13 Strengthen democratic institutions at all levels, and provide transparency and accountability in governance, inclusive participation in decision making, and access to justice.
- 14 Integrate into formal education and life-long learning the knowledge, values, and skills needed for a sustainable way of life.
- 15 Treat all living beings with respect and consideration.
- 16 Promote a culture of tolerance, non-violence, and peace.

Earth Charter (UNESCO, 2003), and Newman (2009) has looked at the use of the Charter as a way of enabling students to assess and clarify their values.

There is, however, an obstacle to be faced at the outset. The full version of the Charter, just like its ‘companion’, the Universal Declaration of Human Rights, is written in language that is inaccessible to most young people. However, a

BOX 2 A version of the Earth Charter for young people

THE EARTH CHARTER

one human family – one earth community

Introduction

We are living at a very important time in Earth’s history. The choices we make today will determine the future of life on Earth.

Earth, our home

Planet Earth is part of an amazing, vast universe. On this planet are many different kinds of plants, animals, and people – all linked to one another in a complex web of life. All forms of life depend on one another and on Earth’s soil, air, and water. Earth provides everything we need. Every man-made thing started from something in nature.

But all is not well ...

People have been wasting much of what they take from nature – plants, animals, water, metals, minerals, oil. Some of these precious resources nature can replace, but it often takes a long time. Others are irreplaceable. Many industries release pollutants into air, water, and soil. While some people have much more than they need, many many others do not have enough food or clean water to stay healthy. Violence, such as war, destroys homes, health, and life.

The principles of the Earth Charter show us what to do.

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| <p>A RESPECT AND CARE FOR THE COMMUNITY OF LIFE</p> <ol style="list-style-type: none"> 1 Respect Earth and all life. 2 Understand, love, and care for the community of life. 3 Find ways for people to live together peacefully and work together for the good of all. 4 Make Earth healthy and beautiful for children of the future. <p>B ALL FORMS OF LIFE ARE INTERCONNECTED</p> <ol style="list-style-type: none"> 5 Protect and restore the web of life. 6 Don’t take chances if there is a possibility that Earth’s environment may be harmed. 7 Live and do business in ways that are healthy for Earth and for people. 8 Share with others what you know about how to protect and restore Earth’s health. | <p>C EVERYONE DESERVES EQUAL OPPORTUNITY</p> <ol style="list-style-type: none"> 9 Guarantee that everyone has enough to meet their basic needs. 10 Be sure that everyone gets a fair share of Earth’s resources. 11 Secure equality for women and girls. 12 Protect the rights of all people to live in dignity, health, and happiness. <p>D PROTECT FREEDOMS AND CREATE PEACE</p> <ol style="list-style-type: none"> 13 The purpose of government is to serve and protect the people. 14 Study and learn ways to protect and restore the web of life. 15 Treat all living beings with respect and consideration. 16 Encourage people to use their words to resolve conflicts. |
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The way forward

People of Earth must join hands to make a new start – to care for Earth and for one another. We have the scientific knowledge and means to clean up our air, water, and soil and to take care of everyone’s basic need but not greed. Every person, every family, every group, every community and every nation can play a part. Let us be remembered as a time of a new beginning in the joyful celebration of life.

young person's version (Box 2) provides only a hint of the richness of thinking enshrined in the more complete and adult text. An early trial with 40 14-year-olds in one school in Bournemouth (Bournemouth Borough Council endorsed the Earth Charter in 2008) produced predictable criticism, even of the version adapted for young people: 'boring', 'too wordy', 'not interesting – no pictures' and so on. At the same time, responses to the question 'Is the Earth Charter important – Why/Why not?' elicited only positive answers, with a remarkably wide range of reasons: 'Yes, because we need to save the world', 'Yes, because it is all to do with what is going on around us', 'Yes, because we need to make sure we don't run out of resources', 'Yes, because it's about our future'.

The Charter has the potential to encourage young people to engage in issues of sustainability and even to inspire them. Earth, our home, faces a multiplicity of interconnected challenges and young people need an opportunity to learn about these while avoiding the fear and 'eco-doom' so frequently portrayed by the media.

A sustainability-orientated framework for teaching science

The Charter provides a wealth of opportunities for discussion of scientific concepts, practical investigation and understanding in all branches of science. Without such scientific understanding, informed decision-making on issues such as climate change and sustainability is not possible. However, the Charter also provides opportunities for examination of fundamental assumptions and presuppositions. For example, the first sub-principle of the Earth Charter (1a) states:

Recognize that all beings are interdependent and every form of life has value regardless of its worth to human beings.

Such a view would lead students to question the mainstream anthropocentric viewpoint and can be used to introduce students to the 'deep ecology' of Arne Naess, the Norwegian philosopher (Naess, 1989) in which all life is experienced as having intrinsic value irrespective of its usefulness to humans. Such an attitude can lead to important investigations and discussions in the laboratory about the values and rights of ecosystems and individual species within them (including spiders and snakes, bacteria and even viruses), together

with possible implications for the use to which we put these entities. The topic of 'interdependence' leads to thinking about systems generally, including the Earth as a living system.

Although, following Lovelock (1979; 2000), science increasingly shows us that Earth is a complex living system, we have little understanding of the almost infinite multiplicity of positive and negative feedback mechanisms between systems that have kept the planet habitable over geological time. So we have limited awareness of the ways in which our interventions can have unexpected consequences on the Earth as a whole. What is clear, however, is that achieving sustainability will require the very best scientific and technological thinking and the widest possible empathy.

There are many further opportunities within the Science National Curriculum to explore issues that the Charter raises. Since there are different ways of learning, some practical or experiential and others conceptual, it is necessary to approach sustainability practically, ethically, conceptually and intuitively, and the Charter provides scope for all of these.

Education curricula often develop empathic maturity in relation to humans and other animals, but students are rarely taught how to extend their empathy to entire ecological communities and of course hardly ever to the entire Earth. Such a move requires the cultivation of one's intuitive faculty – a much neglected and often maligned psychological function that science, for all its emphasis on quantities, cannot do without (Grinnell, 2009). Various methodologies exist to help students develop direct, intuitive perception of the qualities inherent in nature and Ofsted (2008) encourages work outside the classroom. A prominent pioneer in this area in the West was the German poet and scientist Wolfgang von Goethe (Bortoft, 1996), and several contemporary authors are using this approach to create a more holistic science that integrates intuition with our sensing, feeling and reasoning (Goodwin, 1994; Harding, 2009).

The degree of interdependence of the principles within the Charter illustrates superbly the fact that science should not be seen in isolation from the world and humanity. It gives a global breadth to the curriculum, thus meeting another of Ofsted's earlier criticisms that schools are more successful in developing students' understanding

of local rather than global issues of sustainability. Use of the Charter forces science teachers to ask difficult questions, many of which are either avoided, with a preference to leave such 'heavy' issues to personal, social, health and economic education or citizenship lessons, or skimmed over through the teaching of, for example, 'How science works' at key stage 4 (ages 14–16).

An example of how the Earth Charter can help facilitate this might be seen in the key stage 4 chemistry topic 'crude oil extraction and use', where reference to the third 'foundation' of the Charter, 'Social and economic justice', would help students evaluate the implications of the equitable distribution of material wealth. This in turn would demand an in-depth understanding of a range of related issues and concepts far beyond an understanding of alkanes and fractional distillation, including the ramifications of extraction on habitats, associated pollution, its distribution, effects on traditional cultures and a whole range of other issues. Currently, principle 6 of the Charter, which expresses the increasingly important 'precautionary principle' (European Community, 2000; Saunders, 2007), could be examined in relation to the devastating oil leakages in the Gulf of Mexico.

The precautionary principle has a key part to play in the teaching of 'How science works', be it in relation to the use of genetically modified crops and the potential ramifications of releasing recombinant DNA into the environment or the effects of offshore oil drilling or electromagnetic fields from power lines and mobile phones. Had the principle been in existence soon after the Second World War, when the epidemiological evidence for the link between smoking and lung cancer first became apparent, governments may have acted sooner rather than waiting for conclusive evidence of cause and effect, leading to millions dying before their time.

Discussion, debate and the use of 'student voice' strategies such as questionnaires, surveys and so on to ensure active participation, consideration and reflection by all ensures engagement as part of the 'rights, respect and responsibilities' agenda. This is entirely consistent with the aim of the revised National Curriculum (2000) that:

education must enable us to respond positively to the opportunities and challenges of the rapidly

changing world in which we live and work. In particular, we need to be prepared to engage as individuals, parents, workers and citizens with economic, social and cultural change, including the continued globalisation of the economy and society, with new work and leisure patterns and with the rapid expansion of communication technologies.

The Earth Charter works particularly well, therefore, as a focus to bring together the seven cross-curricular dimensions embedded in key stages 3 and 4 of the National Curriculum (QCDA, 2010):

- identity and cultural diversity;
- healthy lifestyles;
- community participation;
- enterprise;
- global dimension and sustainable development;
- technology and the media;
- creativity and critical thinking.

The global or universal dimension of science connects young people with the global environment in which they increasingly live: *'the clothes they wear, the food they eat, the music they listen to, their holidays and the careers they choose'* Brownlie *et al.* (2003).

However, the use of the Earth Charter also demands detailed scientific knowledge and understanding, particularly when dealing with the principles within 'Ecological integrity' (Box 3). These are both explicit and wide-ranging; when they are combined for more precise differentiation and specificity with the 20 sub-principles that support them, they form a comprehensive and interconnected set of guidelines for both protection and, where possible, repair of our planet. The Earth Charter can then be a useful vehicle either for introducing a science topic and gauging student understanding of it or as a review and assessment tool – all within a sustainability framework.

Students could, for example, select a relevant principle themselves through a detailed understanding of the Charter (initially guided by their teacher) and then highlight the key strands the topic impacts upon, perhaps completing a mind map or similar visual representation to feed back to the class and teacher. Students might, for example, examine the proposition, put forward initially by Lovelock (1979; 2000), that Earth is a self-regulating planet where tightly coupled feedbacks between life, rocks, atmosphere and

BOX 3 The principles of the Earth Charter under the 'Ecological integrity' heading

- 5 Protect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain life.
 - a Adopt at all levels sustainable development plans and regulations that make environmental conservation and rehabilitation integral to all development initiatives.
 - b Establish and safeguard viable nature and biosphere reserves, including wild lands and marine areas, to protect Earth's life support systems, maintain biodiversity, and preserve our natural heritage.
 - c Promote the recovery of endangered species and ecosystems.
 - d Control and eradicate non-native or genetically modified organisms harmful to native species and the environment, and prevent introduction of such harmful organisms.
 - e Manage the use of renewable resources such as water, soil, forest products, and marine life in ways that do not exceed rates of regeneration and that protect the health of ecosystems.
 - f Manage the extraction and use of non-renewable resources such as minerals and fossil fuels in ways that minimize depletion and cause no serious environmental damage.
- 6 Prevent harm as the best method of environmental protection and, when knowledge is limited, apply a precautionary approach.
 - a Take action to avoid the possibility of serious or irreversible environmental harm even when scientific knowledge is incomplete or inconclusive.
 - b Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm.
 - c Ensure that decision making addresses the cumulative, long-term, indirect, long distance, and global consequences of human activities.
 - d Prevent pollution of any part of the environment and allow no build-up of radioactive, toxic, or other hazardous substances.
 - e Avoid military activities damaging to the environment.
- 7 Adopt patterns of production, consumption, and reproduction that safeguard Earth's regenerative capacities, human rights, and community well-being.
 - a Reduce, reuse, and recycle the materials used in production and consumption systems, and ensure that residual waste can be assimilated by ecological systems.
 - b Act with restraint and efficiency when using energy, and rely increasingly on renewable energy sources such as solar and wind.
 - c Promote the development, adoption, and equitable transfer of environmentally sound technologies.
 - d Internalize the full environmental and social costs of goods and services in the selling price, and enable consumers to identify products that meet the highest social and environmental standards.
 - e Ensure universal access to health care that fosters reproductive health and responsible reproduction.
 - f Adopt lifestyles that emphasize the quality of life and material sufficiency in a finite world.
- 8 Advance the study of ecological sustainability and promote the open exchange and wide application of the knowledge acquired.
 - a Support international scientific and technical cooperation on sustainability, with special attention to the needs of developing nations.
 - b Recognize and preserve the traditional knowledge and spiritual wisdom in all cultures that contribute to environmental protection and human well-being.
 - c Ensure that information of vital importance to human health and environmental protection, including genetic information, remains available in the public domain.



water have kept the surface habitable since life first emerged around 3500 million years ago. This is an insight that, as cited in the commendation to Lovelock when he received the Wollaston Medal (the highest honour of the Geological Society) ‘has revolutionised our scientific thinking about our planet and our place in it’. Gaia theory links well with Charter principle 5, which stresses that we must ‘protect and restore the integrity of the Earth’s ecological systems, with special concern for biological diversity and the natural processes that sustain life’, since the science of Gaia indicates that biodiversity plays a key role in actively maintaining habitable conditions on the surface of our planet thanks to its intimate and multifarious feedbacks with the rest of the Gaian system.

Similarly, in teaching key stage 4 biology, ‘Drugs and indigenous people’, ‘Ecological integrity’ could be focused on to tease out issues pertaining to healthy habitats and biodiversity and the interdependence of ecology, as well as the fourth area of the Charter, ‘Democracy, non-violence and peace’, which might then highlight habitat destruction in the Amazon rainforest.

Over time, students will appreciate the interconnectivity of the four ‘headings’ and 16 principles of the Earth Charter as a logical and inevitable conclusion, leading not only to a recognition of the complexities of interdependence in the universe but also to a realisation that, although the growth of modern science has depended upon analysis and the breaking down of complexity into simple components, it has become apparent that at times it is necessary to work with the emergent properties of whole systems. These can often not be understood by means of an analysis of the system’s parts in isolation: the whole is more than the sum of its parts. Equally, linear causality is sometimes unable to explain the behaviour of complex systems, such as the weather, where small localised changes can produce large effects in the system as a whole, such as a change of state from liquid to solid or from cold to hot.

Summary

Science has, and undoubtedly will, continue to make a profound difference to humanity and our understanding of ourselves and the world around us. Scientists are trained to be analytical and to reason critically but the Earth Charter asks that

they supplement these abilities and skills by exercising more holistic styles of thinking (such as complexity theory) and by actively engaging in practices that develop intuition, empathy, compassion, creativity and tolerance. The Charter asks communities around the world to develop greater mutual understanding, leading to greater cohesion and understanding. In other words, the Charter advocates a move away from merely learning about sustainability towards practices that foster sustainability in action.

Further, the Charter asserts that if we are to meet the challenges that we face:

the arts, sciences, religions, educational institutions, media, businesses, nongovernmental organizations, and governments are all called to offer creative leadership.

Such interdisciplinary leadership is urgently required even within the scientific community since, in the words of Jeffrey Sachs (2008: 13), Special adviser to the UN on the Millennium Development Goals, we often:

neglect highly effective and low-cost solutions because our very methods of research and governance are not well suited to the challenges of sustainable development. Scientific research proceeds in intellectual silos that make far too little contact with one another; research in the physical sciences, biology, engineering, economics and public health is rarely intertwined, even though we must solve problems of complex systems in which all of these disciplines play a role.

The very existence of the Charter, developed by the widest ever process of consultation between hundreds of organisations and thousands of individuals throughout the world, provides in itself a beacon of hope that, in the final words of the Charter, we may be witnessing ‘*the awakening of a new reverence for life*’ as well as ‘*the firm resolve to achieve sustainability, [and] the quickening of the struggle for justice and peace*’. In the interests of accuracy we should note, of course, that though the word ‘new’ may be appropriate for Western cultures, such reverence is ‘old’ in others, for example Hinduism, Taoism and Buddhism. As educators and scientists, we aspire to open both eyes and minds to the wonders of the world and universe around and within us. We aspire to prepare these young people in our

care for the future ahead. That future has to be a sustainable one, for all our sakes.

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