Educating As If the Future Matters: Tools for Transformative Environmental Education and Sustainable Development Learning

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Introduction

All education is environmental education.
—David Orr

The best educated citizens of the best educated nations in the world are using their best skills to knowingly record in ever greater certainty and detail their accelerating destruction, degradation and deadly pollution of every aspect of the biosphere (Tickell, 2006). This tragedy both motivates and challenges environmental educators, who could do with some additional tools for rapid and radical transformation.

The common factor in the many barriers to environmentally responsible remediative action is that the influential EuroAmerican culture's mindset sets it apart from Nature (Johnston, 2003). Orr (1992), amongst others, laments that the EuroAmerican culture does not question whether it is educating for 'an active, ecologically competent citizenry' (p. 28), and has said that we still educate at all levels as if no sustainability crisis existed (p. 83). Orr implies that Nature is taught out of children by what is omitted from their education. Teachers are called to consciously be making Nature live again in the hearts and minds of students.

This paper is derived from qualitative master's research into barriers to environmental action and 'sustainable development learning' at the community level, as well as empirical research while developing a sustainability curriculum at Upper Canada College, an independent boys school in Toronto, Canada. In light of the state of the biosphere, this paper proposes the following transformative tools:

(1) ecological ethics;
(2) early experiences in the natural world;
(3) science as 'great story';
(4) teaching the evolution‣ecology‣biodiversity‣ecosystem services continuum as an integrated whole;
(5) environmental math and ecological economics;
(6) ecologically inclusive scientific literacy;
(7) environmental history; and
(8) sustainable development learning in action.

Each can be integrated with the others and across the curriculum, at all levels.

Ecological Ethics

No intellectual vice is more crippling than defiantly self-indulgent anthropocentrism. The principal task for humanity is to apply biological constraints on decision making, and apply cultural evolution to biological evolution to create a 'biology of ethics.' The result will be a more deeply understood and enduring code of moral values.
—E. O. Wilson

Global pollution and mass destruction of species are generally not recognized as evils by modern EuroAmerican-based cultures (Pergamon, 2002). The Death of Nature (Merchant, 1982) denotes the death of the European Earth ethic. The absence of an environmental ethic in the EuroAmerican conquest-of-Nature mindset has resulted in a civilization that consumes the Earth and other species with little concern (Pergamon).

But believing that education can be values-free is naive (Nash, 1991). Environmental education cannot be transformative without a solid ethical foundation. The Tbilisi Declaration states that 'environmental education should ... encourage those ethical ... values which ... will further the development of conduct compatible with the preservation and improvement of the environment' (UNESCO, 1978).

Culturally imposed ethics can constrain human destructiveness. The Golden Rule would work, if applied intergenerationally, by conserving and replenishing Nature for future generations. Einstein's ethic was to expand the circle of compassion to all living things. Albert Schweitzer's 'fundamental principle of the moral' was that the good is to preserve life and the evil is to destroy life.

Ecological ethics is not new. Jainism, the ancient Indian religion, prohibits needless harm to all life (Chapple, 2001). 'The individual life is good when it is in harmony with Nature', wrote Zeno of Citium in 300 BC. And African indigenous traditions, like those of North American first peoples, contain ethical messages that are passed from generation to generation to ensure respect for other living creatures (Kelbessa, 2005). Teachers can turn to many cultures and other eras in order to teach ecological ethics.

Nature-Bonding Experiences in the Early Years

We will not enter this kingdom of sustainability until we allow our children the kind of childhood in which Biophilia can put down roots.
—David Orr

'The single greatest challenge currently facing our species is reconnecting people with Nature' (Sampson, 2005). Euro-American culture alienates people from natural environments by physically and psychologically separating them from Nature at the earliest age, in favour of immersion in an artificial/virtual/fantasy world.

Yet, 'direct, personal contact with other living things affects us in vital ways that vicarious experience can never replace' (Pyle, 2003, p. 209). 'Extinction of experience' (p. 209) and 'environmental generational amnesia' (Kahn, 2002) render people less likely to develop an ethic of Nature care.

Research now shows a wide range of beneficial effects of contact with the natural environment on physical health, emotional and spiritual wellbeing, and academic functioning (Foster and Linney, 2007). Undirected play in wild-like places results in environmental citizenship (Wells, 2000).

An ethic of kindness to animals has life-long psychological benefits. Early Nature-connecting makes later environmental education more effective (Foster and Linney). This research will support environmental educators who understand the importance of taking students outside or bringing Nature indoors.

Children's innate biophilia—their natural love and affinity for other living beings (Wilson, 1984)—must be protected and nurtured. '[A] sense of wonder at the rich diversity and complexity of life is easily fostered in children. They spontaneously respond to nature' (AAAS, 1993).

Teachers can model affection and respect for Nature in their language and attitude. Schools can express gratitude together before eating. Science education would be sure to include the dependence of all animals on green plants, that humans are animals, that other animals are social and skilled, and that animals have consciousness and feelings.

Indoors, teachers would make classrooms warm places with tenderness toward plants, kindness to animals, tolerance for spiders, and a Nature corner (Weston, 2005). Outdoors, teachers can help students develop a sense of place by allowing them to explore—literally—the earth beneath their feet. School grounds can be enhanced with naturalized areas. All students should plant seeds and tend plants.

Natural history is learned in Nature. Letting children 'be' in Nature is vital for creating a generation of students who grow to care for, and care about, the natural world.

Life as Great Story

A coherent story of our origins—a powerful and true myth—can act as an effective intellectual vehicle ... in the building of a whole new legacy.
—Eric Chaisson

The dominant EuroAmerican narrative has told humans they are separate from Nature, that Nature is corrupt and something to be controlled, a belief compounded by the post-industrial mechanistic way of understanding life processes (Bowers, 1997; Merchant, 1982). This 'story' influences curriculum (and the hidden curriculum).

In contrast, the Great Story (Universe Story or Evolutionary Epic) is what Maria Montessori calls 'a spectacular vision of the universe'. The science of cosmogenesis and evolution connects humans to the universe, Earth and all life. The Great Story provides humanity a common creation story, a narrative that 'embraces yet transcends all scientific, religious, and cultural stories' (Dowd, 2002). 'For the first time in human existence we have a cosmic story that is not tied to one cultural tradition . . . but instead gathers every human group into its meanings' (Swimme, 1998).

The Great Story serves as a superior way for students to make sense of the world, and offers a powerful integrating theme in education. Montessori presented 'the whole of the universe as a framework for all the children's later knowledge' (Lillard, 1996, p. 55), and based her education on five 'Great Lessons', starting with stories of the universe and the coming of life. Her method has been validated by research (Lillard, 2005).

Theologic historian Thomas Berry (1988) taught the Universe Story as the context for all human understanding. 'Both education and religion need to ground themselves within the story of the universe. . . . Within this functional cosmology we can overcome our alienation and begin the renewal of life on a sustainable basis' (http://www.thegreatstory.org/).

Teaching the Evolution ➤Ecology ➤Biodiversity ➤Ecosystem Services Continuum as an Integrated Whole

A major task for evolutionary biologists is to explain the origin of biodiversity.
—Peter R. Grant

Reductionism in education fragments the story of life, making it less intelligible while disconnecting students from Nature. Evolution reveals the unity in diversity of life. An understanding of the evolutionary process leads to comprehension of the principles of ecology and appreciation of how irreplaceably precious the diversity of life is to humanity, through ecosystem services or 'Nature's gifts'. This integrated continuum forms the basis for studying the life sciences and natural history—the stories of life.

Darwin explained that it is not the strongest nor the most intelligent of species that survive, but the species most responsive to change, so it is an ignorance of evolution that perpetuates the competitiveness ('survival of the fittest') ideology (Costall, 2004). Darwin's work and writings included the importance of mutualism and co-evolution, and inspired the new field of ecology (Haekel, 1866).

'United in a single theme, evolution and ecology provide a powerful lens through which to view life's web, forming the foundation of an integrated and underutilized perspective on Nature' (Sampson, 2005). According to biologists like Betsey Dyer, today's biodiversity is billions of years of evolutionary symbiosis (in Olson, 2005). Many people, however, lack knowledge about biodiversity, and fail to perceive a link between species preservation and humanity (Foster-Turley, 1996). Making these connections allows students to see the essential value of ecosystem services such as soil regeneration and water purification.

A further vital reason for teaching this integrated unit at all levels is to effectively address the sixth mass extinction event, for which modern culture is mainly responsible. 'The science of biodiversity has become the science of our future' (Levin, 2004).

'As educators, we must demonstrate that the marvelous, interwoven complexity that characterizes every ecosystem, ancient and modern, is the result of a co-evolutionary dance that has required millions upon millions of years' (Sampson, 2005).

Environmental Mathematics and Ecological Economics

Economic thinking ... is peculiarly unable to consider the long term and to appreciate man's dependence on the natural world.
—E. F. Schumacher

To most educators, environmental math may sound strange, but the two go together well. Scientific literacy requires skill in math, as does learning about ecology and environmental systems. There is plenty of math to be discovered in the natural world, from patterns in Nature to Nature's engineering, and a symbiosis exists between basic scientific principles and their mathematical expressions in Nature (Adam, 2003). Excluding Nature from the math classroom is unnatural. Including Nature would enliven the subject. The Mathematical Association of America has a Mathematics and the Environment website to guide this integration (accessed 30/3/2007 at http://infohost.nmt.edu/%7Ewdstone/www/EnvironMath/CommEnvMath.htm).

Young students can be taught sustainability using simple math, such as sharing. Basic mathematics—percents, ratios, graphs and charts, sequences, sampling, averages, growth, calculus, variability and probability—all relate to current, critical issues such as pollution and the sustainable availability of resources. Understanding the math of exponential growth and limits to growth is essential for environmental literacy. Mathematical modelling is essential in assessing global environmental change. Online curricula teach math through current global issues, including population growth, biodiversity, climate change, natural resource use, and ecological footprint (see, for example, the Qualitative Environmental Learning Project, accessed 30/3/2007 at http://seattlecentral.edu/qelp/).

The absence of Nature in math is extended to the math of economic accounting. To most economists, Nature does not count because it is an externality, and GDPs are calculated by counting environmental losses as economic benefits. This is despite new environmental accounting methodologies and the application of ethics in modern academic economics (Stern, 2006; Stiglitz, 2002). Exponential, limitless economic growth continues, so environmental depletion, degradation, and pollution have now exceeded the planet's carrying capacity (World Wildlife Fund, 2006). Global warming is the worst market failure ever (Stern, 2006). Conventional economics is terrible math, devastating for Nature, and fatal for the future. The solution is to teach the mathematics of sustainable development by insisting on integrating social and environmental costs in the teaching of economics.

Ecologically Inclusive Scientific Literacy

Scientific literacy may likely determine whether or not democratic society will survive into the 21st century.
—L. M. Lederman

Scientific literacy rates in industrialized countries are shockingly low (Miller, 2007). In many jurisdictions, definitions of scientific literacy exclude reference to the natural environment (Aikenhead, 2002). The policy of Canada's education ministers serves as an example to follow, as it includes environmental literacy. 'Students will develop an understanding of the nature [Nature?] of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology (CMEC, 1995).

Carl Sagan (1997) warned that the consequences of scientific illiteracy have become extremely dangerous. 'It's perilous and foolhardy for the average citizen to remain ignorant about global warming, say, or ozone depletion, air pollution, toxic and radioactive wastes, acid rain, topsoil erosion, tropical deforestation, exponential population growth' (pp. 6-7).

And yet, these consequences continue every day, around the world. 'Most of us no longer have any idea of what is scientifically plausible and what is scientific nonsense. In this hyper-technological age, where so many things, perhaps even our survival, depend upon subtle decisions by a scientifically informed citizenry, that ignorance is deeply alarming (Homer-Dixon, 2001).

Educators need to include ecological literacy in teaching for scientific literacy (Margadant-van Arcken, 2002). Students cannot be expected to judge what they do not fully understand. They need to be taught causality; weight of evidence; peer review; feedback loops; shifting baselines; different timescales; exponential growth; the precautionary principle; ecological limits to science; some knowledge of the world around them, locally (natural history) and globally (state of the planet); principles of sustainable development; and especially the science of global warming, because sustainability depends on their eco-inclusive scientific literacy.

Environmental History

The historians, even when articulating world history, deal not with the whole world but just with the human, as if the human were something separate from or an addendum to the story of the Earth and the universe. —Brian Swimme and Thomas Berry

One of the most striking indications of the modern cultural disconnect from Nature is the exclusion of the natural environment from history teaching. To remedy this disconnect, all history would include, indeed focus on, environmental history.

History teaching has traditionally portrayed the history of the Earth in terms of wars, great civilizations, and human achievements, ignoring environmental contexts that triggered—or were caused by—these events (Leemans and Costanza, 2005). In contrast, environmental history 'draws on social, political, economic, and intellectual history, the history of science, and the roots of environmental values' (Merchant, 2006). It could also include examples of more sustainable cultures.

The goal of environmental history is to understand how humans have affected and been affected by their natural environment, and with what results. Understanding past environmental change is a prerequisite for understanding future change. (Leemans and Costanza, 2005). Students need to learn the history of the state of the planet (shifting baselines) to be able to work on sustainability solutions. As one important example, older students need to learn the history of the current, human-driven, mass extinction of species (Eldredge, 2001). Environmental history timelines are available from the Worldwatch Institute (http://www.worldwatch.org/brain/features/timeline/) and Professor William Kovarik (http://www.runet.edu/~wkovarik/envhist/).

History is often taught as values-free, so the record of Euro-American destructive wars and oppressive exploitation escapes moral censure, allowing terrible socio-environmental mistakes to be repeated. In contrast, environmental history places the past in an ethical framework. For example, because of Africa’s colonial history of subjugation, African environmental history has made its contribution by refiguring colonialism in environmental terms, placing an emphasis on the history of environmental injustice and eco-racism (Carruthers, 2005).

Students conclude what matters to their culture—and what does not—by what is left in or out of 'his story' (Orr, 1992, p. 85). History does not teach for a sustainable future. Socio-environmental history—'our story'—does.

Sustainable Development Learning in Action

The great aim of education is not knowledge, but action.
—Herbert Spencer

Sustainable development, as formulated at the United Nations Rio Earth Summit in 1992, is ethics in action, resulting in intra- and intergenerational equity as the way to peace and sustainability. It is a new expression of an age-old concept, one practised in traditional cultures (Orr, 1992). An example is the Haudenosaunee Great Law of Peace, an ethic mandating the welfare and wellbeing of the seventh generation to come (accessed 30/3/2007 at http://www.ratical.org/many_worlds/6Nations/#ISCD).

Agenda 21 is the UN's comprehensive and detailed 'action plan' for sustainable development (including, as important examples, peace making, internalization of social and environmental costs, and the precautionary and polluter pays principles), capable of transforming the economics barrier to sustainability.

According to Koïchiro Matsuura, UNESCO Director General, 'The principles of sustainable development must find themselves in children's schooling. This means that education will have to change so that it addresses the social, economic, cultural and environmental problems that we face in the 21st century'. Linking sustainability with teaching about the state of the planet offers a powerful integrating theme throughout education.

Local sustainable development action by students is transformative for them (Leigh, 2005). Young students can grasp the sustainable development concept when presented as an ethic of fairness (Johnston, 2007). For older students, it can be taught in science, civics and geography courses by integrating the economic, social equity, and environmental aspects of every topic in each course (the key principle of sustainable development). Graduating students should be competent in sustainability before entering the workforce.

For educational purposes, see (accessed 30/3/2007):

- A condensed Agenda 21 (http://www.iisd.org/rio+5/agenda/riodocs.htm)
- Canadian Youth Action Guide for Agenda 21 (http://www.lsf-lst.ca/en/teachers/agenda21.php)
- Rescue Mission: Planet Earth (http://www.unicef.org/publications/index_6446.html)
- International Institute for Sustainable Development Timeline (http://www.iisd.org/rio+5/timeline/sdtimeline.htm)

- Interactive Learning About Sustainable Development (http://www.iisd.org/educate/learn.htm)

Learning about sustainable development—its history and 'story', its principles and processes, and its promise—can lead to action for sustainability (Johnston, 2003). The Earth Charter (http://www.earthcharter.org/) calls for education to 'provide all, especially children and youth, with educational opportunities that empower them to contribute actively to sustainable development'. Environmental educators can teach about sustainable development in compelling, experiential ways that lead to, well, sustainable development. The future depends on this.

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