Editorial

From the Editor

Somehow, in the midst of a hectic summer, fall has come upon me and *Connections* is late. My deepest apologies for the delay, both to the patient authors and the (hopefully) equally patient readers.

This issue of *Connections* was intended to address climate change. The topic has manifested itself through articles on fish, water availability, wind power, a new definition of wealth, poetry and teaching children bicycle safety—a drop in the proverbial bucket of the myriad ways in which climate affects us. In addition, I am pleased to reprint two articles on climate change from legal experts at the Environmental Law Centre in Edmonton, Alberta, and an article on teaching about global warming from the *Alberta Science Education Journal.*

Probably the best teachers' resource on the subject is the book *Teaching About Climate Change: Cool Schools Tackle Global Warming.* Edited by Tim Grant and Gail Littlejohn of *Green Teacher* magazine, the book features contributors (educators themselves) who look at the issue from many angles and pitch it to many age levels. With the quality of projects we expect from *Green Teacher,* this book could jump-start many projects in your classroom and generate enthusiasm in your students.

Please review the schedule for submissions on page 2—there have been some changes.

I would like to announce that I will be stepping down as publications editor in spring 2004. Receiving so many incredible, unique articles and poems, each written with passion and from the heart, has been wonderful. Without them, this experience would have been empty, indeed. Thank you! A big thank you also goes to the photographers, whose art has lifted *Connections* to a new level. This issue features the desert photography of GEOEC past president Louella Cronkhite.

If this job catches your imagination, contact me for details on what it means to be publications editor. I know that our next editor is out there somewhere!

Reference

Grant, T., and G. Littlejohn, eds. *Teaching About Climate Change: Cool Schools Tackle Global Warming.* Gabriola Island, B.C.: New Society, 2001.

—Karin Adshead

Schedule for Submissions

Connections seeks articles on the following topics.

Theme: Sacred Spaces
Deadline for submissions: November 30, 2003

- Your sacred space
- How do we abuse or undervalue other people's sacred spaces?
- Teaching children to see a space as sacred
- Book reviews
- Valuing the sacred spaces of children
- Sacred space where you work, live and play
- Feng shui
- Leaving a sacred place behind: a refugee's story
- Sacred space from the Muslim, Christian, Buddhist or aboriginal perspective—a personal story

Theme: A Sense of Wonder
Deadline for submissions: March 1, 2004

- Rachel Carson: woman, scientist, history maker
- How do you get children to open to their sense of wonder?
- How do you get teenagers to hold on to their sense of wonder?
- A personal journey of discovery: the moment you reclaimed your lost sense of wonder
- Poetry on the beauty of nature
- Photography and artwork celebrating nature's wonders
- "All things bright and beautiful, all creatures great and small"
- A personal account of experiencing life's wonder and living in tune with nature
- A moment of wonder that propelled you into a career in environmental and outdoor education
- An account of the person who inspired you to see the wonder of nature

Connections also requires submissions for the following regular features:

- What's Happening (and Where)—sharing events and programs related to global, environmental and outdoor education
- Resource Feature—highlighting resources related to global, environmental and outdoor education
- Who You Gonna Call?—identifying people or organizations that offer valuable and possibly unusual resources to teachers
- Reach for the Stars—celebrating models of excellence through profiles and case studies

Submissions of 2,000 words or less and written in an informal (but not careless) style are preferred. *Connections* readers are educators and interpreters involved in environmental, global and outdoor education at any level. Keep in mind that teachers really appreciate examples of working ideas that they can take into the classroom (indoors or outdoors). You will receive a copy of the issue that features your article.

Connections also needs artists and photographers to submit their work. If you have photos, drawings or other artwork that would complement any of the above themes, let me know.

How Do I Make a Submission?

Sending submissions by e-mail is ideal, but you may also submit articles or artwork by regular mail (on a diskette or as hard copy). Please include a two- or three-sentence biography and your mailing address.

Send submissions to Karin Adshead, 2D 8725 96 Avenue, Edmonton, AB T6C 2B1; e-mail karin.adshead@earthchallenge.com.

Photo Contest

Connections is holding a photo contest in three categories:

- Our natural world
- People in nature
- Children at play in nature

Photos should be sent ASAP to Karin Adshead, 2D 8725 96 Avenue, Edmonton, AB T6C 2B1; e-mail karin.adshead@earthchallenge.com. The winners will be announced at the GEOEC annual conference in May 2004. The prizes are yet to be determined. All submissions will be featured in upcoming issues of *Connections.*

GEOEC Business

GEOEC Awards

GEOEC seeks nominations for the following awards.

Appreciation of Service Award

The Appreciation of Service Award is presented to member and nonmember individuals and organizations in acknowledgment of service contributing to the professional growth of GEOEC members.

Considerations include service, events, hosts, materials, sponsors, affiliate organizations and departments that have been of significant benefit to the Council.

Award of Merit

The Award of Merit is presented to member or nonmember individuals or organizations in recognition of exemplary teaching, leadership or service in the field of global, environmental and outdoor education.

Considerations include teaching, leadership or service representing a significant commitment of effort and time; effective influence on the development of global, environmental and outdoor education in a region, province or nation; contribution to the awareness and understanding of an environmental ethic; or extension of teaching practice, research, legislation or funding in global, environmental and outdoor education.

Distinguished Fellow Award

The Distinguished Fellow Award is presented to a member in acknowledgment of outstanding achievement and distinguished service in the field of global, environmental and outdoor education.

Considerations include years of service, significance of achievements, effect of leadership and commitment to the Council's development and operations.

To nominate an individual or group, complete the nomination form included with this issue. Please complete a separate form for each nomination. To be considered by the awards committee, nominations must be accompanied by a rationale highlighting contributions in terms of service, leadership or commitment in time and effort in the field of global, environmental and outdoor education.

Nominations should be sent by **March 31, 2004,** to Louella Cronkhite, GEOEC Past President, 63 Grand River Boulevard W, Lethbridge, AB T1K 7P1; e-mail lcronkhite@shaw.ca.

The awards will be presented at the GEOEC annual conference in Nordegg, Alberta, in May 2004.

Seeking Conference 2005 Director

Attention GEOEC members!

Are you interested in meeting people? Are you full of creative ideas? Are you committed to global, environmental and outdoor education?

If you answered yes to these questions, you may be interested in becoming the Conference 2005 director! We are looking for committed people with vision and initiative.

If you are interested in directing or assisting with Conference 2005, contact Liz Goodwin at (780) 486-1215.

GEOEC Wins National Award

GEOEC has won the Canadian EECOM Excellence in Environmental Education Award in the category of Environmental Education Organization. The Canadian Network for Environmental Education and Communication (EECOM) is a multisectoral and multiregional organization that works to improve environmental education in Canada. The awards are open to environmental educators and organizations across the country. The October 2, 2003, press release states,

> The Global, Environmental and Outdoor Education Council (GEOEC) is a model of what can happen when dedicated individuals pool their resources to bring a vision to reality. Consistent volunteer leadership in pedagogical organizations is a problem faced by educators across the country. Taking on the challenges that GEOEC set for itself is an exceptional task, rivaling the energy needed of venture capitalists in hard economic times! The increase in membership of their organization, the proliferation of educational environmental programs, and the revitalization of such an educational organization is nothing short of extraordinary. There is no doubt that GEOEC is a most deserving winner of the EECOM award for an outstanding environmental education membership organization.

The EECOM awards were presented in Prince Edward Island on September 26, 2003, at the EECOM annual conference by Diane Griffin, P.E.I.'s assistant deputy minister of fisheries, aquaculture and environment.

For more information about the awards, contact Grant Gardner, EECOM chair, at (709) 737-8155 or ggardner@mun.ca.

For more information about EECOM, visit www.eecom.org.

Articles and Features

Wanna Buy Some Hot Air?: A Brief Legal Overview of GHG-Emissions Trading

Cindy Chiasson

One option being considered as a tool in reducing greenhouse gas (GHG) emissions and meeting Canada's reduction target if the Kyoto Protocol is ratified is emissions trading. Both the federal and Alberta governments have indicated clear interest in pursuing GHG-emissions trading as an important part of any effort to reduce domestic GHG emissions. However, many do not clearly understand emissions trading and its significance in relation to GHG reduction and climate change. This article will discuss this matter, together with related legal issues.

What Is Emissions Trading?

Simply put, emissions trading is a means of using market forces to encourage emissions reductions. Commonly, emitters are allocated permits that allow them to emit a specific level of pollutants. Emitters that can reduce emissions at a lower cost will be able to sell any excess permits to those who may face a higher cost of emission reduction. The philosophy underlying emissions trading is that these trades of emissions permits will ultimately achieve emissions reductions at a lower total cost than simply imposing regulated reduction levels for all emitters.

Why Is Emissions Trading Significant to Climate Change?

The Kyoto Protocol ("the Protocol") specifically provides for emissions trading as a means to be used by countries to achieve their GHG-reduction targets agreed to under the Protocol.[1] The Protocol contemplates transfers of "emission reduction units" between Annex I countries, subject to certain conditions set out in the Protocol.[2] It also provides that the parties to the Protocol will develop a system for emissions trading, including requirements for verification, reporting and accountability.[3] This points to the ultimate development of an international system for GHG-emissions trading if the Protocol is ratified.

GHGs are particularly amenable to emissions trading, as their environmental effects are global, rather than localized. As such, GHG-emission reduction in any part of the world will provide an environmental benefit in relation to climate change generally. This reinforces the potential for GHG-emissions trading on an international basis.

What Laws Would Be Required for Emissions Trading in Canada?

A complicating factor in establishing a Canadian system for

GHG-emissions trading is the fact that constitutional authority for environmental matters is shared between the federal government and the provinces. Due to this split jurisdiction, the optimum situation for development of a domestic GHG-emissions-trading system would be a cooperative undertaking between the federal government and the provinces, as it is unclear which level of government might have authority to create and administer a trading system without cooperation of the other level of government. Ultimately the constitutional authority for creation of emissions-trading systems will depend in large part on the legal characterization of such a legislative scheme.[4]

Both Alberta and the federal government have legislative provisions that would enable them to develop emissions-trading systems. The Environmental Protection and Enhancement Act enables Alberta's minister of environment to establish programs and measures for the use of economic and financial instruments and market-based approaches, including emissions trading. However, this must be done in accordance with regulations; there currently are no provincial regulations enabling the creation of emissions-trading systems.[5]

In the federal arena, the Canadian Environmental Protection Act, 1999, enables the minister of environment to create guidelines, programs and other measures for economic instruments, including systems of tradeable units.[6] However, the minister is obliged to offer to consult with provincial governments on these matters. The minister may proceed to act 60 days after making such an offer if it is not accepted; the act is silent as to the minister's options should a provincial government agree to consult but not agree with the federal approach.[7] Quite detailed enabling powers are provided under the act to the federal cabinet to make regulations creating trading systems.[8] The act also provides the minister with what is effectively an emergency regulation power in relation to established trading systems.[9]

Some Other Considerations

It is likely that an effective Canadian GHG-emissions-trading system will require the participation and cooperation of both the federal and provincial levels of government. The strong indications from the Kyoto Protocol of the likely creation of an international emissions-trading system and the role of the federal government in ensuring the implementation of international obligations point toward the

Photo by Louella Cronkhite

necessary involvement of the federal government in development of a Canadian trading system. However, the provinces will also have a very relevant role to play in developing such a system.

An important element of any GHG-emissions-trading system will be credibility and transparency of the system. Given the lack of understanding by much of the general public of climate change as a whole and public mistrust of government, industry and financial markets, there is likely to be scepticism on the part of the public as to the actual value and environmental efficacy of an emissions-trading system. It will be important to have a trading system that is based in law rather than policy, with strong enforcement and significant penalties for noncompliance. Such a system should also include means to control and minimize the possibilities of fraud, such as third-party audits or other verification of credits. A scientifically supported basis for caps on emissions will also be relevant in creating a credible GHG-emissions-trading system, while a system which reduces the capped level of emissions over time will aid in achieving ultimate GHG reduction.

One important matter to keep in mind in relation to GHG-emissions trading is that a trading system will not be the sole tool for achieving GHG reductions. GHG-emissions trading must be considered by governments and likely participants in suite with other reduction options. This is especially relevant for those sectors that are unlikely to be covered by an emissions-trading system, for example, transportation or individual fossil-fuel use.

Notes

1. Kyoto Protocol to the United Nations Framework Convention on Climate Change, December 10, 1997, UNFCCC COP, 3d Sess., UN doc. FCCC/CP/1977/L.7/Add.1

2. Ibid. at Art. 6

3. Ibid. at Art. 16 bis.

4. For more detailed discussion of constitutional and legislative issues related to emissions-trading systems, see Atkinson (1999). Another helpful source is Rolfe (1998).

5. R.S.A. 2000, c. E-12, s. 13

6. S.C. 1999, c. 33 at s. 322

7. Ibid. at s. 323

8. Ibid. at s. 326

9. Ibid. at s. 327

References

Atkinson, E. *The Legislative Authority to Implement a Domestic Emissions Trading System.* Prepared for the Multistakeholder Expert Group on Domestic Emissions Trading, National Round Table on the Environment and the Economy. Ottawa: National Round Table on the Environment and the Economy, 1999.

Rolfe, C. *Turning Down the Heat: Emissions Trading and Canadian Implementation of the Kyoto Protocol.* Vancouver: West Coast Environmental Law Research Foundation, 1998.

Cindy Chiasson is the executive director of the Environmental Law Centre in Edmonton, Alberta.

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Centre Reviews Alberta's Proposed Climate-Change Legislation

Cindy Chiasson

In November 2002, the Alberta government introduced Bill 32, the Climate Change and Emissions Management Act, which was intended to establish the legislative framework for implementation of the provincial climate-change plan.[1] The bill was not passed in the fall 2002 legislative sitting and was newly introduced as Bill 37 in the spring 2003 legislative sitting.[2] Debate on second reading of the bill was adjourned on April 28, 2003, until the fall legislative sitting. The Environmental Law Centre ("the Centre") took the opportunity to provide its comments on Bill 32 by submitting a detailed brief that reviewed the bill and made over 30 recommendations for revision and improvement.[3] This article provides an overview of the changes between Bill 32 and Bill 37, in light of the Centre's comments.

Bill 32—The Starting Point

In essence, Bill 32 sought to lay the blueprint for implementing the Alberta climate-change strategy, by minimally setting out basic legislative requirements and granting broad regulation-making powers to flesh out the details. Major hallmarks of Bill 32 included broad discretion in government officials and cabinet, minimal public involvement and little detail on the ultimate shape of the provincial climate-change plan. This bill also sought to clearly claim provincial jurisdiction to regulate climate-change matters and to minimize the potential federal role in the area by claiming ownership of greenhouse gases as natural resources and constituting provincial targets and limits as the only applicable numbers within Alberta.

The Centre's Comments

An initial matter raised by the Centre was whether Alberta needs a separate climate-change framework at all, given the broad, comprehensive nature and established framework of the Environmental Protection and Enhancement Act.[4] Virtually every element of Bill 32 could be achieved through limited amendments to that act, which also offers the advantages of a time-tested framework and a primary focus on environmental protection. The Centre's brief also discussed the constitutional aspects of Bill 32 and climate-change regulation as a whole and suggested that the most likely constitutional resolution of this matter would be one of shared jurisdiction and cooperation between the federal and provincial governments.[5]

The Centre also suggested that major improvements were needed in the province's climate-change legislation. These suggestions included

- explicit recognition of environmental protection as the legislation's primary goal;
- greater detail for processes related to regulatory and policy development and implementation of the legislation, especially in relation to emission-reduction tools;
- reduction in the amount of discretion in the legislation and imposition of more limitations on any remaining discretion;
- expanded and stronger structure for compliance and enforcement of the legislation; and
- changes to clarify and guarantee a strong public role in various elements of the legislation.

Bill 37—The Positives

While much of Bill 37 mirrors the content of Bill 32, some notable changes have been made. Consistent with the Centre's analysis and recommendations on constitutional matters, Bill 37 has been modified

to take a more conciliatory and cooperative approach to addressing climate change. This includes explicit provisions enabling cooperation with other jurisdictions and removal of references to ownership of greenhouse gases as natural resources. The importance of environmental protection as a facet of climate-change management has been recognized in the preamble to Bill 37. The new Bill also provides a broader scope for emissions-reduction tools, beyond trading systems, and recognizes the need to be compatible with regulatory schemes of other jurisdictions.

Other changes are also consistent with Centre recommendations. Bill 37 has made modifications to the structure of the Climate Change and Emissions Management Fund by giving its administration to the minister of finance and providing the ability for the government to appropriate monies for the fund. The bill also provides some minor softening of provisions related to imposition of sectoral agreements by regulation.

Bill 37— The Concerns

While positive changes were made with the introduction of Bill 37, many of the concerns expressed by the Centre with respect to Bill 32 remain. Bill 37 still provides for broad grants of discretion and regulation-making power for many important elements such as structure and process. As a whole, Bill 37 continues to separate creation of the bulk of Alberta's climate-change management system from open and public debate and scrutiny.

Bill 37 also lacks a clear role for the public in climate-change management. It does not provide for public consultation or participation related to any of its important key elements. A new provision dealing with confidentiality of information is of concern because it raises the spectre of less, rather than more, accessible information. Section 17 empowers the government to prescribe types of information provided to it that would have restricted access and length of time that access could be restricted, while overriding the provisions of the Freedom of Information and Protection of Privacy Act.[6]

While changes to the provision dealing with ownership of carbon sinks remove the confusing wording of Bill 32, the new provision leaves the whole matter of ownership to the regulations, creating less certainty for those who might own such sinks, for example, farmers and woodlot owners.

Conclusion

The changes made in Bill 37 are, for the most part, positive in nature. However, there is much in the bill that still merits improvement. It should be amended to provide greater detail and structure to processes for developing the details and implementation of the legislation. Amendments are also needed to reduce the amount of discretion given to government officials and limit what discretion remains; provide explicit processes for public participation, consultation and access to information; and create more structure for the compliance and enforcement system.

The provincial government should also release draft regulations for public review and consultation, ideally before enacting Bill 37. If such a step is not taken, a commitment should be made to publicly review draft regulations before implementation of the new climate-change legislation, to allow a full and fair public airing of the entire climate-change management system for Alberta.

Notes

1. Bill 32, Climate Change and Emissions Management Act, 2d Sess., 25th Leg., Alberta, 2002

2. Bill 37, Climate Change and Emissions Management Act, 3d Sess., 25th Leg., Alberta, 2003

3. The full text of the Centre's brief, *In Response to Bill 32: The Climate Change and Emissions Management Act*, is available as a free download from the Centre's website at www.elc.ab.ca. Print copies of the brief can be purchased from the Centre.

4. R.S.A. 2000, c. E-12

5. For a more complete review of the constitutional matters, see Mallet (2003).

6. R.S.A. 2000, c. F-25

Reference

Mallet, J. "Constitutional Support Lacking for Alberta's Bill 32." *News Brief* 18, no. 1 (2003).

Cindy Chiasson is the executive director of the Environmental Law Centre in Edmonton, Alberta.

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Global Warming as an STS Topic in the Senior High Science Curriculum

Liliya Sukhy

The climate is always a hot topic of discussion. We wonder if it will snow tomorrow or be sunny next week. We wonder if it will be a mild spring or a wet fall. We wonder why the past few winters have been so mild, with little snow, or why the spring is unusually wet. Many are concerned about how Earth's warming climate might affect its ecosystems. Some do not acknowledge the problem of changing climate; however, according to Brown (1996, 1), "there is no longer any scientific doubt that we are causing the Earth's climate to change. Global warming is not a distant theory but a fact of our lives."

Public concern about global warming has increased as a result of many reports warning of its consequences. According to Abrahamson (1989, 3), those "consequences could be second only to nuclear war." Many scientists believe that global warming greatly threatens our survival. If they are right, an international effort is needed to deal with this global problem. Educators can contribute to this effort by teaching students to think critically about global warming; in particular, they can help students to understand the role of science and technology in global warming and to become aware of the actions they can take to reduce global warming.

This article presents an overview of global warming, research on students' understanding of global warming and a strategy for teaching global warming as a science, technology and society (STS) topic in the senior high science curriculum.

Global Warming

The History of Climate Change

Earth's climate has changed significantly throughout its history. For example, Earth was once warm enough for abundant vegetation to grow on far northern islands such as Greenland. "That warm period started 130,000 years ago and ended 117,000 years ago with the return of cold temperatures that led to an ice age" (Calvin 1998). Today, Greenland is almost totally covered with thick layers of snow and ice.

Earth has apparently experienced seven major ice ages in its recent history. Each ice age consisted of alternate periods of warming and cooling. Scientists believe that this climate change is caused by a combination of astronomical factors, such as "the planet's angular tilt, its axial precession (a 'wobble' that occurs in the planet's orientation to the sun on a 23,000-year cycle), and a 100,000-year variation in the shape of the planet's orbit around the sun" (Newton 1993, 6).

Currently, Earth seems to be undergoing a general warming trend—global warming. Many blame global warming on human activity (Khandekar 2000). Michaels and Balling (2000, 11) write, "The idea that human beings could change global climate developed in the 19th century, with the realization that certain industrial emissions—notably carbon dioxide (CO_2)—could alter the rate at which heat escaped from the lower atmosphere." Human activity has always affected the composition of the atmosphere. For example, the fires of the earliest prehistoric people released CO_2, carbon monoxide (CO), soot and other gases into the atmosphere. But, as Christianson (1999) points out, the volume of gases released by

those fires was very small compared with the total volume of the atmosphere.

Since the Industrial Revolution, however, human impact on the composition of the atmosphere has increased significantly. The widespread industrial use of fossil fuels such as coal, oil and natural gas may be a direct cause of the steady increase over the past 150 years of atmospheric levels of the products of fossil-fuel combustion, such as CO_2, CO and methane (CH_4). These gases, called greenhouse gases, are released faster than Earth can recycle them. According to the U.S. Environmental Protection Agency (EPA 2002), "Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide have increased nearly 30%, methane concentrations have more than doubled, and nitrous oxide [N_2O] concentrations have risen by about 15%." The EPA (2002, 1) concludes, "These increases have enhanced the heat-trapping capability of the earth's atmosphere." As a result, global temperatures are rising. The U.S. National Research Council (1999, 239) stresses that "over the past few decades concentrations of atmospheric gases (CO_2, CH_4, N_2O) have been increasing dramatically and have moved into a range unprecedented for the past million years. The increase has produced serious concern regarding the heat balance of the global atmosphere." Calvin (1998) suggests that these recent gaseous additions "could lead to dramatic cooling—a catastrophe that could threaten the survival of civilization."

The Greenhouse Effect

The World Meteorological Organization (WMO 1990, 5) attributes global warming to atmospheric conditions "brought about by the so-called greenhouse effect." To make this causal association, we must determine that the magnitude of the warming is larger than natural climate variability and consistent with the greenhouse warming mechanism. Abrahamson (1989, 40) states, "Global warming has reached a level such that we can ascribe with a high degree of confidence a cause and effect relationship between the greenhouse effect and the observed warming."

The natural greenhouse effect is necessary for life on Earth. An atmosphere above Earth's surface "acts like a blanket that traps heat from solar radiation coming to the Earth from the sun" (Halmann and Steinberg 1999, 1). Like the glass in a greenhouse, the atmosphere allows incoming solar radiation to pass through. Most of this radiation is absorbed by Earth's surface, warming it, but some is reflected. Earth, in turn, emits infrared radiation. The atmosphere, in its natural state, allows some of the infrared radiation to pass through to space. Naturally occurring atmospheric greenhouse gases—such as water vapour, CO_2, CH_4, nitrogen oxides (N_xO) and ozone (O_3)—absorb or re-emit the rest of the radiation. This raises the temperature of the atmosphere near Earth, which in turn maintains sea levels while regulating evaporation and precipitation, leading to a global cloud cover that contributes to the distribution of climate across the surface of the planet (Brown 1996). Scientists hypothesize that, if the atmosphere did not contain greenhouse gases, Earth's mean temperature would be approximately 33°C lower. Naturally occurring greenhouse gases, then, facilitate the conditions that allow most plants and animals to live on Earth (Thompson 1991).

The greenhouse effect becomes a problem only when levels of greenhouse gases increase beyond natural levels. Water vapour and CO_2 are largely responsible for the greenhouse effect, and atmospheric levels of both gases can be changed through biological, human and geological events. Some scientists have calculated that, since World War II, approximately 75 per cent of the changes in the amounts and combination of greenhouse gases is a direct result of human activity (David Suzuki Foundation 1999; Michaels and Balling 2000).

Humans release CO_2 into the atmosphere through the combustion of solid waste, fossil fuels (coal, natural gas and oil), and wood and wood products. Because trees naturally absorb CO_2, deforestation also contributes to increased levels of CO_2 in the atmosphere; Edgerton (1991) estimates that, in the 20th century, deforestation was responsible for 10–30 per cent of the increase in atmospheric CO_2 levels.

Methane (CH_4) also contributes to the greenhouse effect. This gas is naturally produced during the anaerobic decomposition of organic matter in swamps, marshes, landfills, and freshwater and marine sediments and during the burning of biomes. It is also naturally released from the intestinal tracts of cattle,

sheep and termites; as Newton (1993) notes, the average cow releases a kilogram of CH_4 each day. Abrahamson (1989, 253) suggests that an "increase in atmospheric methane could be due to the greater amount of area devoted to rice cultivation." He also claims that between 350 and 600 million tonnes of CH_4 are released into the atmosphere annually, with 60 million tonnes accumulating in the troposphere, where it remains for about 10 years. The David Suzuki Foundation (1999) notes that, "although total methane emissions are much smaller than CO_2, it is a far more potent greenhouse gas with 21 times as much global-warming potential per molecule as CO_2. Methane is responsible for about 12% of Canada's contribution to global warming."

The David Suzuki Foundation (1999) attributes 11 per cent of Canada's contribution to global warming to the release of nitrous oxide (N_2O), which "has a global-warming potential 310 times greater than CO_2." The main sources of N_2O are agricultural and industrial activities, such as the breakdown of chemical fertilizers and the combustion of solid waste and some fossil fuels.

Powerful anthropogenic greenhouse gases are the hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). HFCs were developed as a substitute for chlorofluorocarbons (CFCs). CFCs were created in the 1930s as extremely stable, nontoxic and nonflammable gases that are easy to liquefy under pressure; however, they proved to be dangerous to health and food supplies, are responsible for severe damage to the ozone layer and may contribute to global warming (Brown 1996; Wigley 1999). HFCs work on the same principles as CFCs but, because they do not contain chlorine, are not as harmful. However, they "have a global-warming potential which ranges from 140 to 11,700 times greater than CO_2" (David Suzuki Foundation 1999). HFCs are used as cleaning fluids for electronic components, in refrigeration and in the manufacture of semiconductors. PFCs are released during the aluminum-refining process and "have a global-warming potential 7,400 times greater than CO_2" (David Suzuki Foundation 1999). SF_6, generally released as a byproduct of magnesium production, "has a global-warming potential 25,000 times greater than CO_2" (David Suzuki Foundation 1999). Together, "these emissions account for 1% of Canada's contribution to global warming" (David Suzuki Foundation 1999).

Changes in Earth's Temperature

According to Halmann and Steinberg (1999), Earth currently has an average surface temperature of 15°C (if there were no atmosphere, the surface temperature would be –19°C). When levels of atmospheric greenhouse gases increase, more heat is trapped and Earth becomes warmer. This warming, in turn, increases evaporation rates, which adds more water vapour to the atmosphere, causing further warming—to a point.

Records show that, between 1880 and 1940, Earth's average temperature increased by about 0.5°C. Between 1940 and 1970, Earth's average temperature increased by only 0.13°C. After 1970, however, another increase began, ending in the "greenhouse decade" of the 1980s, a period that included six of the 10 warmest years ever recorded (Boden, Sepanski and Stoss 1991). The warmest year on record is 1998 (Environmental Defense 2000). According to Wigley (1999), in the 21st century global warming may range from 1.9°C to 2.9°C. However, Michaels and Balling (2000, 105) cite Karl's argument that the unusual warmth of 1997 and 1998 indicates an overall increase in this century of 3°C:

> Karl looked at the 16 consecutive warm months that dominated 1997–1998, and argued that the projection of 2°C of warming in the next 100 years is too low. He searched the model statistics and found that there is only a 5% chance that such a 16-month period would occur if the warming were going to be this low, but the chance goes up to 50% if the models forecast an additional degree of warming in this century.

Malcolm and Pitelka (2000) predict an increase of 1°C to 4°C. Jaimet (2001) estimates an overall increase of 5.8°C. English, Wong and Kochtubajda (1990, 5) assert that, "with respect to Alberta, an increase in the average annual temperature of about 5°C, a modest overall increase in total annual precipitation with increases or decreases in specific regions and seasons, and both positive and negative impacts are anticipated by about 2050."

The Potential Effects of Global Warming

It is clear that we are facing in the 21st century an overall increase in Earth's mean temperature attributable at least in part to industrial activity. No one knows for certain the effects of this increase, but a warmer Earth surely will be challenging, if not disastrous, for humans and other life forms.

Increasing global temperatures could cause thermal expansion of seawater and melting of ice caps, which would result in rising sea levels. The sea rose 10–15 centimetres in the 20th century and is predicted to rise another 15–90 centimetres in the 21st century (Woods Hole Research Center n.d.). Halmann and Steinberg (1999) state that, at current rates, by the year 2100 sea levels could rise between 15 and 90 centimetres, with a best estimate of 48 centimetres. Rising sea levels would be catastrophic. Coastal cities, islands and low-lying countries such as Bangladesh and the Netherlands would be inundated. Because some Pacific island states are no more than 1 metre above the current sea level, a rise of more than a few centimetres could spell disaster. A 50 centimetre rise would be enough to flood a part of the Maldives, the Nile Valley of Egypt and sections of Bangladesh; a 1 metre rise would flood 6 per cent of the Netherlands and 80 per cent of the Majuro Atoll in the Marshall Islands (Brown 1996). Rising waters would force the citizens of many small island nations to migrate elsewhere because these islands lack the coastal defence systems needed to cope with higher water levels. Currently, an estimated 46 million people worldwide are at risk of such flooding; this number will increase to 92 million if sea levels rise 50 centimetres (Woods Hole Research Center n.d.). A rise in sea levels would permanently inundate wetlands and lowlands, accelerate coastal erosion and flooding, alter ocean circulation and affect the ecosystems of marine biomes. Flood damage to human coastal settlements would increase because higher water levels provide a higher base for storm surges, erosion would increase the vulnerability to storm waves, and decreased natural and artificial drainage would increase flooding during rainstorms. Increased salinity from a rise in sea levels could convert swamps to open water and threaten drinking-water supply (Kaya and Yokobori 1997).

Global warming could intensify the water cycle, producing increased precipitation in some areas and severe drought in others. A recent study by Day, Trenberth and Karl (cited in Khandekar 2000) supports this prediction: they found increased drought in some areas and moisture surpluses elsewhere. Over the last century, precipitation has increased by about 1 per cent worldwide.

Global warming could result in an extension of the hurricane season and in hurricanes occurring at higher latitudes (Wong et al. 1989). This would dramatically affect ecosystems, including changing terrestrial ecosystems as plants and animals follow the shifting climate. In fact, Malcolm and Pitelka (2000, iv) suggest, "The effects of global warming on terrestrial ecosystems may already be altering ecosystems properties and species distributions."

Global warming could affect the growth and regeneration capacity of forests in many regions, especially at high latitudes and in the tropics. Some types of forests may disappear and new ones may be established. Studies show that, within the next 100 years, many forest species may migrate between 160 and 544 kilometres in the direction of the poles (Woods Hole Research Center n.d.). Reduction of the glaciers would allow some vegetation and agriculture to relocate to higher elevations, whereas species that exist only at high elevations may become extinct. Fuel and food resources for the mountain population and recreational industries could be disrupted. Timber and mining production could be affected. In the northern latitudes, increased CO_2 in the atmosphere could increase plant growth, crop yields and agricultural productivity, but in the tropics and subtropics the opposite would occur, possibly leading to increased famine (Budyko, Golitsyn and Izrael 1988).

Global warming will likely have broad adverse impacts on human health. Heat waves can cause cardiovascular and respiratory diseases. Death, injuries, psychological disorders and indirect health effects will be caused by floods, storms and ecological disturbances (Nordhaus and Boyer 2000). Halmann and Steinberg

(1999) suggest that global warming will lead to an increase in diseases such as malaria, dengue, yellow fever and encephalitis. They suggest that even a 3°C to 5°C rise in temperature will increase malaria transmission by 45–60 per cent in the 21st century and increase air pollutants, pollen and mould spores, which will, in turn, increase the incidence of respiratory diseases, asthma and allergies.

Almost every prediction paints a negative picture of life on Earth as a result of global warming. Though it is clear that human contribution to global warming should be reversed or reduced, less obvious is the most effective course of action. Some suggest that attempts to subdue global warming should begin with educating our children.

Students' Understanding of Global Warming

DeCanio et al. (2000) report that many researchers in climate policy blame scientific and technological development for global warming. However, scientific and technological knowledge is needed to minimize the impact of global warming. Thus, global warming is an essential STS topic in the senior high science curriculum.

Andersson and Wallin (2000, 1096) suggest that "to fully understand environmental issues, students must develop knowledge not only about Nature, but also about Technology and Society, as well as interactions among these three systems. In short, it is a question of understanding system 'NTS.'" Henriksen and Jorde (2001, 190) write, "To prepare students for responsible participation in the debate about the global warming issue, decision-making skills and training in the critical use of experts are being put forward as important features of the new science education." In Alberta, global warming is included as an STS topic in senior high biology, physics and chemistry.

However, studies suggest that senior high students do not fully understand the issues associated with global warming. Henriksen and Jorde (2001) found confusion between global warming and other environmental issues. According to their research, senior high students confuse global warming with ozone depletion and incompletely understand the greenhouse effect. Moreover, students believe that global warming will cause the sea level to rise as a result of melting glaciers, whereas scientists believe that thermal expansion will be the greatest contributor to the anticipated rise in sea level.

Andersson and Wallin (2000, 1096) found that students "do not fully understand what fundamental societal changes would occur as a result of a drastic reduction in CO_2 emission." They confuse the depletion of the ozone layer with the greenhouse effect, and they believe that environmentally friendly actions will solve all environmental problems. For example, many students believe that using unleaded gasoline will reduce global warming.

A study by Blades et al. (2000) shows that approximately 30 per cent of senior high students believe that the greenhouse effect and ozone-layer depletion are the same. Their research suggests that "significant gaps exist between what the students should know about environmental issues and their knowledge as they conclude their final year of high school" (p. 15).

Boyes, Chuckran and Stanisstreet (1993) also found that many students confuse major environmental problems such as global warming, ozone depletion, the greenhouse effect, radiation pollution and acid rain. The authors point out that, although students better understand these issues as they grow older, there are still misconceptions among many secondary school graduates.

Groves and Pugh (1996) blame such misconceptions on teachers' incorrect instructions. Their research suggests that some teachers do not have a correct understanding of environmental issues. Science teachers must "be sufficiently aware of these issues and their interrelationship so that they can more properly guide their students to correct understandings" (p. 12).

Implications for Teaching

To help students make good decisions about serious environmental issues, teachers should include more topics and classroom activities to help students understand the possible effects of global warming and the possibilities for preventing or reducing global warming. This requires changing the

existing science curriculum to include a greater STS emphasis.

Blades et al. (2000, 15) suggest that "one approach to an effective environmental education may be direct instruction through particular units that focus on environmental education." These units should emphasize the issues surrounding global warming, such as the impact of and interrelationships between science, technology and society; the consequences of human activity for the environment; and what students can do to protect the environment. By engaging in practical activities that develop authentic solutions to global warming, this generation of students may more fully understand the current situation and the possibilities for action.

To better understand key issues, senior high students could be required to complete a major three-step project on the causes and effects of global warming. In the first step, students prepare a portfolio of articles they have collected on global warming. They should gather as much information as possible, including scientific studies and dissenting opinions, to reflect a broad examination of the issues. The portfolio could also include journal entries that reveal students' evolving opinions about global warming from the perspectives of their lives, their community and planetary dynamics.

In the second step, students consider the political dimension of environmental issues such as global warming. This expansion of their inquiry might begin with an examination of the extent to which science textbooks neglect this dimension. This could be a springboard for further studies on how the media portray environmental debates, such as the controversy surrounding the Kyoto accord and its rejection by various provinces and countries. Students could examine the political perspectives of newspaper and magazine articles on global warming, and expand their search to include other media such as websites. The evaluation criteria, decided upon in class discussion, might include such factors as how the media present information that is current, relevant and useful. Websites can be especially useful for up-to-date information, as long as students are alert to the political messages of the sites. Many websites include lessons, activities, videos, games and other materials that help students understand the impact of science, technology and society on global warming. At the end of this article is a list of websites students might use to better understand global warming.

The third step of the project is the most difficult. When discussing the projects, students should be challenged to list personal-action projects that may reduce global warming. Not only the teacher but also a variety of stakeholders—including peers, parents and community members—should evaluate these projects. Such broad assessment will emphasize to students the importance of dealing with global warming. The projects should give students the opportunity to communicate their understanding of global warming with other students and community members. Students should be expected to evaluate, justify and defend their proposed courses of action among their peers and through community-based forums. In this way, theory moves to practice as students work with the community to find practical alternatives to current practices.

Conclusion

Global warming is an important international issue with potentially serious consequences for humankind and the biosphere. Many scientists suggest that global warming will result in rising sea levels. Global warming will also likely contribute to increased desertification, movement of agricultural growth into the northern temperate zone, drought in some regions and increased precipitation in others, damage to human health, and damage to or even destruction of ecosystems.

We face a problem of global dimensions that will affect all nations on a scale never before seen. The encouraging fact is that educators can do something about it. As Alberta Education (1995) points out, science teachers should help senior high students become aware of society's responsibility to protect the environment. Students should also develop an understanding of global warming and the greenhouse effect. We must increase the emphasis on environmental studies, particularly global warming, in the senior high science curriculum so that our actions today might alleviate the looming crisis.

Recommended Websites on Global Warming

Acorn Naturalists
www.acorngroup.com
This online store carries educational resources on a variety of environmental topics, including an activity in which students construct a miniature greenhouse.

Climate Change Solutions
www.climatechangesolutions.com
This website, a Pembina Institute project, helps students learn about climate change and offers a contest to find solutions to climate change.

Congressional Research Service Reports: Climate Change
www.cnie.org/NLE/CRS/Detail.cfm?Category=Climate%20Change
This website contains reports on the scientific, political and economic issues related to global warming and the policy responses that have taken place.

Environmental News Network (ENN)
www.enn.com
This website provides news on current environmental issues.

Environmental Protection Agency's Global Warming Site
http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html
This website offers information on climate change, greenhouse gases, the effects of global warming and actions one can take. It also contains resources that teachers can use in classroom activities.

Global Warming Project
www.letus.nwu.edu/projects/gw/
This website contains activities that help Grades 7–10 students understand the causes and effects of global warming.

GLOBE Program
www.globe.gov
In the GLOBE program, students worldwide take scientifically valid environmental measurements, contribute those measurements to a database, and create online maps and graphs to analyze the data. The website also contains videos and games.

Great Plains Regional Center (GPRC) for Global Environmental Change
http://gprcnigec.unl.edu/education.htm
This website contains lessons on the causes and effects of global warming and activities that allow students to learn about global warming through investigation.

Institute for Global Environmental Strategies (IGES)
www.strategies.org
This website contains activities that illustrate global warming and its causes and effects. It contains complete lesson plans, instructions, background information and worksheets.

New York Times Learning Network
www.nytimes.com/learning/teachers/lessons/environment.html
This website contains activities, explanations and handouts introducing students to Earth's warming mechanism and the role of greenhouse gases in global warming.

Science of Global Warming
http://school.discovery.com/schooladventures/globalwarming/
This DiscoverySchool.com website contains an activity for senior high students in which students research and then debate both sides of the global warming controversy.

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Liliya Sukhy is a graduate student in the Department of Secondary Education at the University of Alberta in Edmonton, Alberta.

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"Hear Ye, Hear Ye!": Climate Change as a Messenger

Elizabeth Paschen

Climate change as a result of human activity undoubtedly began in the murky heydays of coal furnaces and smoke-belching trains. Natural-gas heating hid the carbon-drenched truth from our industrial mindset across half a century. Competitive growth among Western nations has enormously increased fossil-fuel burning for electric production. Now it appears that the drawbacks of atomic fuels waste disposal are less feared than rising CO_2 levels in the atmosphere—Ontario, among other jurisdictions, has pondered commissioning atomic fuel generators! The good news is that even the most stubborn administrations are admitting that an ounce of prevention is less costly than a pound of cure and that encouraging less road traffic and developing cleaner fuels for transportation, power generation and industry are prudent.

The beautiful truth is that cleaner fuels are bountiful and available worldwide. For example, Iceland is blessed with geothermal heat brought to the surface by geysers. That wise country will soon produce all its power and heat from that source. Several major European nations—including Spain, Germany, Sweden and Britain—aim to increase their total production of wind and wave power from an already impressive rate of 15 per cent to 30 per cent by 2020. Denmark has had a university devoted entirely to wind-power technology for 10 years—this in the face of easy access to North Sea oil. Of course, Holland has used wind power to pump water from its lowlands for centuries and is now a leader in modern gearless wind

Photo by Louella Cronkhite

turbines requiring minimal maintenance.

Now Canada is among the enthusiastic wind-power producers, as a new wind farm west of Fort Macleod, Alberta, takes its place as the highest Canadian producer. The United States is also moving ahead with great expectations all down the windy central plains, from the Dakotas through Texas. Meteorological sciences suggest that the winds from those 10 states could produce all the electricity required by the whole United States! Alberta's windy south could provide for 25 per cent of the province's current electricity needs. Sadly, we provide only 2 per cent at this time. We need not despair, though: the very industries that have dismissed wind and solar power as being too expensive are now revising their assessment and putting their shoulder to the wheel, so to speak.

As the fossil-fuel sources diminish, workers can be enticed to develop new skills in turbine-blade manufacture, concrete-tower construction, instrument and control design and monitoring, and special adaptations for cold-climate and offshore applications in a country bordered by three major oceans. Obviously, the installation of a turbine large enough to generate electric power for 300 average Alberta households requires a skilled work team and large machinery for transport, footings and placement.

Thus, climate change is a good messenger, requiring us to refine our skills as we stretch our imaginations to find a better paradigm in which we can look out for each other.

Editor's note: Educating Alberta households about ways to increase energy efficiency could greatly increase the number of households that could be serviced by a single turbine.

The Meaning of Wealth

Mark Anielski

> The Gross National Product includes air pollution and advertising for cigarettes, and ambulances to clear our highways of carnage. It counts special locks for our doors, and jails for the people who break them. GNP includes the destruction of the redwoods and the death of Lake Superior. It grows with the production of napalm and missiles and nuclear warheads. And if GNP includes all this, there is much that it does not comprehend. It does not allow for the health of our families, the quality of their education, or the joy of their play. It is indifferent to the decency of our factories and the safety of our streets alike. It does not include the beauty of our poetry or the strength of our marriages, or the intelligence of our public debate or the integrity of our public officials. GNP measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile.
>
> *—Robert F. Kennedy, 1968*

What Is Wealth?

> It is said that we know the price of everything and the value of nothing.
>
> *—Anonymous*

Most of us associate wealth with money, savings, investments, homes and other forms of financial capital.

But did you know that the word *wealth* comes from the Old English *weal* ("well-being") and *th* ("condition"), which together mean "the condition of well-being"? Did you know that the word *economic* comes from the Greek *oikonomia,* meaning "the management of the household"? When have you heard economists or business analysts report on the conditions of household living and management? The word *mortgage* in French literally means "a pledge unto death," or what I call "a grip of death." How we have twisted the meanings of words!

The father of accounting, Luca Pacioli, a 16th-century Franciscan monk and mathematician, never defined *wealth* and *profit.* To this day, accountants have no clear definition of either word.

If real, or genuine, wealth is about more than financial possessions and if accountants have no true understanding of how to define, measure or account for this wealth, then we have a wonderful opportunity to both redefine and rediscover our genuine wealth.

With that opportunity, I have developed a system for assessing and managing genuine wealth. *Genuine* means "having the qualities or value claimed." *Genuine wealth* can be defined, as Robert F. Kennedy noted, as "that which makes life worthwhile." Most of us could define what that is in a few minutes.

My genuine-wealth system attempts to align our community's values and principles with the actual conditions of our well-being (personal, professional, spiritual, environmental and financial). The system is a tool and a process for measuring or assessing the physical and qualitative conditions of all the things that make life worthwhile. A genuine-wealth assessment is similar to an annual medical checkup in that it provides a total diagnosis of life's real wealth.

Most of us are accustomed to looking at wealth strictly in financial terms or in terms of property and possessions. But real wealth is much more than that, and we know it intuitively.

Most of us would define genuine wealth in terms of our relationships with our partners, children, parents, friends and neighbours. We would see genuine wealth in the beauty of a sunset and the flutter of butterfly wings. We would measure wealth in terms of the joy of our play, the social cohesion of our neighbourhoods and the quality of our children's play. We wouldn't measure wealth in terms of our military spending, war, the development of prisons, the cutting

down of ancient forests or increases in the Dow Jones Industrial Average.

Yet, conventional economics and business indicators of prosperity—such as the gross domestic product (GDP), stock-market indices and other economic indicators reported daily—have little to do with what we would define as genuine wealth. Indeed, many of these indicators, like GDP growth, do not distinguish between expenditures in the economy that contribute to genuine-wealth development and those that result in the depreciation or erosion of our social fabric or the strength of our relationship with nature. So, why do we focus on these indicators when most of us long for development of our relationships with each other and the land?

Another important word is *value,* which comes from the Latin *valorum,* meaning "to be worthy." Here again we see the confusion of our age. So often we associate value only with monetary expressions (prices, costs, returns on investment). But real value (*valorum*) is found in the things that make life worthwhile: genuine wealth.

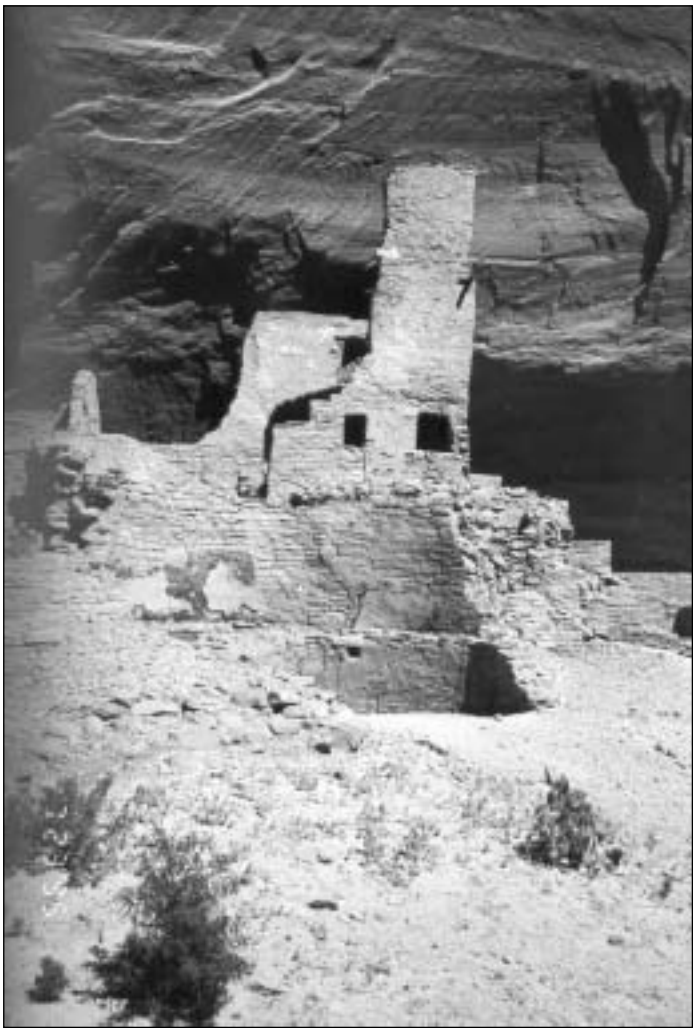

Photo by Louella Cronkhite

Even a more common word, *capital,* has lost its meaning. *Capital* is synonymous with the word *wealth* and is defined in *Webster's New World Dictionary* as "wealth, in whatever form, used or capable of being used to produce more wealth."

If *capital* means "wealth," *wealth* means "the condition of well-being" and capital assets are any form of wealth (tangible or intangible), this suggests a new approach to both the measurement and management of real wealth or real capital.

Real capital, or life capital, is the assets or aspects of each human being—so-called human capital—along with social and natural capital.

Human capital is generally defined as "the knowledge, skills, competencies, and other attributes of each individual that facilitate the creation of personal, social, and economic well-being" (Healy and Côté 2001). In the indigenous cultures of North America, a human being has four aspects: emotional, physical, spiritual and mental. A complete human being has a healthy balance of these core assets or capabilities. We exercise these assets through volition (our willpower) in pursuing our vision or dream of the good life.

Social capital is the value of relationships we have with each other. By definition, *social capital* is the "relationships, networks and norms that facilitate collective action" (Healy and Côté 2001), including such things as social cohesion and formal and informal institutional arrangements.

Natural capital is the natural resources or environmental assets

and systems that provide humanity with nature's materials and services that are vital to economic well-being.

How do we measure genuine wealth and real assets, and assess the conditions of well-being that contribute to our quality of life?

Accounting for Genuine Wealth

> Accounting is a mirror into our souls. Where we spend our money discloses our true values, what we hold important.
>
> *—Dan Rubenstein*

> To give away money is an easy matter, and in any man's power. But to decide to whom to give it, and how large and when, and for what purpose, and how, is neither in every man's power, nor an easy matter. Hence it is that such excellence is rare, praiseworthy, and noble.
>
> *—Aristotle*

The genuine-wealth framework provides a solution—a model and practical tool for measuring and managing genuine wealth: all the things that make life worthwhile and resonate in our hearts.

Genuine wealth is an accounting of life, like a window on our souls or a mirror image of our genuine selves.

The genuine-wealth framework is both a process and an accounting tool for getting in touch with our core values, assets and capabilities. Today more than ever society faces the challenge of sustaining a quality of life unprecedented in human history. How do we celebrate what we have? What assets contribute to a complete and balanced human being? What makes for a healthy and flourishing community and economy? What contributes to the good life? How do we celebrate businesses that are genuinely dedicated to building the good society and are stewards of the common weal, while remaining dedicated to the strengths of business: innovation, entrepreneurship and profitable enterprise?

The genuine-wealth model provides an alternative to the tired economic-growth and accounting models. It accounts for what we value most and allows us to objectively assess our real assets (our strengths) and opportunities for developing our real-wealth potential.

Genuine wealth is about getting in touch with all the things that make life worthwhile, as Robert F. Kennedy so long ago encouraged us to do. So, what makes life worthwhile for you? Are you investing in genuine wealth?

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Mark Anielski is a genuine-wealth economist and expert on quality-of-life measurement. He teaches corporate social responsibility in the School of Business at the University of Alberta in Edmonton, Alberta, and ecological economics at the new Bainbridge Graduate Institute near Seattle, Washington. He lives in Edmonton and can be reached at anielski@telus.net.

Wars over Water: In the Making or Started Already?

Enneke Lorberg

In an age of increasing globalization and threats to human security, access to water has become the most critical issue worldwide. The increasing demand for more water for a growing population and the exploitation of more and more of the freshwater supply have resulted in a crisis.

Has our civilization reached a dangerous climax in water use from which there is no turning back? Where has all the water gone? Are we running out of fresh water for just a while or forever? Which countries are preparing pre-emptive strikes to monopolize access to water resources?

The global threat to water-resources management must be discussed in schools and communities.

Hydraulic Societies

Should we rewrite history from an access-to-water perspective, as one great philosopher of history, Karl Wittfogel, started doing? His synopsis of world history analyzed several hydraulic societies—societies dependent on complex irrigation systems—that form the basis for his generic model of societies. Great civilizations have flourished or collapsed depending on how they met the challenge of managing watersheds.

Historically, control over water supply has been the linchpin to keeping civilizations and communities alive. Earlier civilizations managed to get off the ground and maintain themselves effectively for long periods of time through secure, well-planned and long-term access to sufficient and safe water supplies.

For example, the Mesopotamians were inventive and effective in water-resource management and development, thriving in a place highly prone to flooding and dry spells and making optimal use of the ample sunshine and warmth of the climate. The cycles of the Tigris and Euphrates rivers did not coincide with the cropping season. The peak flows of the two rivers occurred in April and May, just when the grain was ready for harvesting, and the high floods completely wiped out the crops. The flood waters receded in June during the hot planting season. The Mesopotamians found a solution: different social classes performed different duties to properly manage the water resources. This strategy resulted in an extremely stratified but effective hydraulic society in which the upper class (priests and administrators) supervised.

Collective management of water resources appears to be the most crucial survival strategy for any empire, country, region, province or community (see studies by Barlow [1999], De Villiers [1999], Postel [1999] and Shiva [2002a]). Controlled, monitored and often centralized access to safe and sufficient water has been the litmus test for survival of powerful countries and big empires.

Reverence for Water

In traditional societies, water was treated with the utmost reverence. Water was approached ceremonially and used every day based on a deeply spiritual perspective. Early civilizations treated water as a god-given and unique substance that provided and supported all life. Water is still greatly revered in many nonsecular cultures.

Wonderful ceremonies and a set of rules are in place to maintain an ongoing and vibrant relationship with water—an entity as unique and irreplaceable as the earth we walk on and the air we breathe in. For example, Muslims maintain this deep respect for water. And Vandana Shiva (2002a) explains how people in India revere water with a religious fervour as the life-giving and transcending force in their communities.

A remnant of the traditional attitude toward water can be seen in our society, where water diviners are still held in respect by some. Diviners practise their ancient water-dowsing techniques with utter confidence and dedication all over the world, including rural Alberta. Divining is a fascinating method of finding water, and even though extensive and well-documented scientific research by hydraulic engineers and geologists has tried to prove that divining is more make-believe than applied science, the belief in dowsing is alive and well. In fact, as controversial as divining may be with scientists, it has been shown to work very well all over Africa to this day.

Crisis in Water-Resources Management

An imminent crisis in management of water resources is occurring all over the world.

There is a prehistory to this crisis. Assumptions about water as a given forever are false: water will not just fall from the sky forever. Around the world, alarm buttons are being pushed to call immediate attention to water as a finite resource. Because of intensive urbanization, increasing deforestation, water diversion and industrial farming, Earth's surface is drying up at a phenomenal speed. If these trends persist, the water in all the river basins on every continent will be rapidly depleted.

How much fresh water is left for the global population? The population has doubled since 1950 and will double again in 30 years. The renewable water consists of total runoff (snow and rain run to the sea). Only one-third of this runoff is accessible, and of that we have already used up one-half. In another 30 years, we may have used it all. Where do we get more? Maybe we will have to search for good fresh water on another planet because we have ruined ours.

Water Facts

- Fresh water amounts to less than 0.5 per cent of all Earth's water. The rest is seawater or is frozen as polar ice.
- Fresh water is renewed by rainfall at a rate of only 14,000–15,000 cubic kilometres per year.
- Global water consumption is doubling every 20 years, which is more than twice the rate of human population growth. According to the UN, more than 1 billion people already lack access to fresh drinking water. By 2025, the demand for fresh water is expected to rise 56 per cent above what is currently available.
- Of the 6 billion people in the world, 2 billion face water shortages today. By 2025, that figure will increase to 5.5 billion.
- Oceans cover 71 per cent of Earth's surface and contain 96.5 per cent of Earth's water.
- Almost 70 per cent of Earth's fresh water is frozen, permanent snow cover, ice and permafrost.
- 30 per cent of all fresh water is underground, most of it very deep in the earth in hard-to-reach areas.
- Earth's lakes and rivers contain a little more than 0.25 per cent of all fresh water.
- At least 70 per cent of Earth's fresh water is used for agriculture.
- Of all the water on Earth, 97.5 per cent is salt water and only 2.5 per cent is fresh water.
- Of the fresh water on Earth, 68.7 per cent is in glaciers, 30.1 per cent is in groundwater, 0.4 per cent is permafrost, and 0.4 per cent is surface and atmospheric water.
- Of the 0.4 per cent of surface and atmospheric water, 76.4 per cent comes from freshwater lakes, 12.2 per cent is soil moisture, 9.5 per cent is atmospheric, 8.5 per cent is from wetlands, 1.6 per cent from rivers and 0.8 per cent from biota.

Water and Health

Each year, 25 million people (60 per cent of whom are children) die from diseases caused by unsanitary conditions. Most of these diseases are directly related to water:

- Water-borne diseases are spread by drinking or washing hands or food utensils in contaminated water. These diseases are transmitted by a vector, which spends part of its life cycle in water. Human contact with infected water allows the parasite to enter humans through the skin, eyes or mouth. Diseases with water-related vectors pass through infection-carrying insects breeding in stagnant water.
- Fecal-disposal diseases are caused by organisms breeding in waste when sanitation is inadequate.

- About 1.3 billion people (26 per cent of the world's population) lack safe drinking water and 1.7 billion (34 per cent) lack adequate water for sanitation.
- Nearly half of the developing world does not have access to safe water.
- Of the rural population in 70 African and Asian countries, 80 per cent does not have access to safe drinking water.
- One-quarter of the world's population lacks safe drinking water and sanitation.

- Approximately 1.2 billion people drink unclean water.
- Approximately 2.5 billion people lack proper toilets or sewage systems.
- More than 5 million people die each year from water-related diseases such as cholera or dysentery.

Water and health are intricately interwoven. The key is how to make and keep water safe for human consumption. An excellent synopsis of the history of urban water improvement can be found in *Something New Under the Sun: An Environmental History of the Twentieth-Century World* by J. R. McNeill (2000). In the chapter "World Water Use and Supply" (pp. 122–47), he describes how, in 1885/86, 90,000 people around Chicago died of water-borne diseases. Then, typhoid sickened about 20,000 Chicagoans each year from 1891 to 1895. These epidemics provoked the U.S.'s largest engineering project before the Panama Canal: the Chicago Metropolitan Sanitation District, which reversed the flow of the Chicago and Calumet rivers so that, by 1900, they no longer emptied into Chicago's drinking-water supply but, instead, flowed toward the Illinois River and down to the Mississippi River. The *New York Times* contained the headline "Water in Chicago River Now Resembles Liquid" (whereas before it was more concentrated sludge). Typhoid and other water-borne epidemics became memories, and the water became potable because of an efficient sewage-treatment system.

We assumed for a long time that much progress had been made in Western countries until recently, when the same old water problems resurfaced in so-called modern and fully developed countries. In Canada, there was a sudden alarm about the lack of water-safety standards endangering people's lives. In fact, monitoring and maintaining water-safety standards has become a nightmare in our so-called modern and advanced country. (For example, the Walkerton, Ontario, case revealed alarming and systemic neglect in monitoring water-safety standards.)

Water and development are intricately linked. Access to safe water is a basic human right. The lack of it could, alone, cause a country to declare war.

Irrigation

Sandra Postel's (1999) study *Pillar of Sand: Can the Irrigation Miracle Last?* analyzes the pros and cons of modern agriculture and its handmaid, irrigation. Postel explores whether the Green Revolution (technological development of agricultural techniques) ended because excessive irrigation proved unprofitable, costly and exhaustive in water use.

Irrigation had its heyday from the 1950s to the 1970s. Large investments were made and economic growth seemed secure. All but seven of the world's largest dams were completed right after World War II. The waste proved enormous: at least 60–70 per cent of the water used in irrigation is wasted. Irrigation uses 70 per cent of the global water supply, industry

uses 20 per cent and residences use 10 per cent.

Experts have identified many problems with irrigation, including the following:

- Maintaining channels is difficult. Silting, breaching and salinization occur.
- There is the plight of the tail-enders—the poor and small farmers left out of the profitable irrigation business. The basic question is, Irrigation for whom and for what? Just for export of monocultures?
- There is an increasing imbalance between the rapidly growing population (increasing by 1.8 per cent per year) and irrigation (increasing by only 0.9 per cent per year).
- Irrigation has an ecological toll: water logging, soil salinization, contamination of land and water by salts and toxic chemicals, and draining of aquifers. This toll may make irrigation unsustainable and too costly.

There are many examples related to the last problem:

- The beautiful Kesterton National Wildlife Refuge in California is now a disaster area because of irrigation.
- Irrigation is depleting the Ogallala Aquifer, which runs southward from South Dakota and Nebraska to the Texas high plains.
- In Libya, the Great Man-Made River project for irrigation resulted in desertification.
- Russia's Aral Sea, once the world's fourth-largest lake, has shrivelled and its watershed is poisoned because the sea was diverted for irrigation.

The area of the world's irrigated land has dramatically increased over the past 200 years (Jensen, Rangeley and Dieleman 1990):

- In 1800, 8 million hectares
- In 1900, 48 million hectares
- In 1950, 94 million hectares
- In 1970, 198 million hectares
- In 1990, 220 million hectares

Irrigation developed by leaps and bounds then suddenly slowed down. The variables at play were low food prices, higher energy costs, deteriorating economic conditions and the rising costs of dam building for irrigation. So, the price of water for irrigation went up.

The expense of developing new irrigation projects proved the greatest in Africa. When we try to rearrange the planet's distribution of water resources and re-create greenbelt in desert or dry areas through the magic of irrigation, we must pay an ecological price. The conclusion from the global perspective is that irrigation can be improved in critical ways so that it can pass the sustainability test.

The Green Revolution was adopted and broadcast as the biggest breakthrough in modern agriculture in the 1960s and 1970s. The Food and Agriculture Organization (FAO) introduced high-yield variety (HYV) strains of cereals all over the world. Use of these seeds required high inputs of fertilizer, pesticides and, above all, water. The HYV seeds boosted food production, especially in developing countries. In Indonesia and the Philippines, where irrigation was available and conditions were favourable, yields rose by over 3 per cent per year. India doubled its wheat yield in 15 years, and rice yields in the Philippines rose 75 per cent. However, the research focused only on cereals that could be stored easily and traded for profit on the world market, and ignored crops grown by small farmers in Africa and Latin America, such as cassava, sorghum and millet.

The storage of HYVs is troublesome and hazardous because they carry a lot of moisture and easily grow moulds. They also do not grow well on marginal soils, where small peasants do their subsistence farming. Moreover, they only produce high yields when used with large amounts of expensive agrochemicals and water.

The following statistics illustrate what was happening globally in food production in the 1970s: fertilizer use doubled, pesticide use increased fivefold and the area of irrigated land rose from 160 million hectares to more than 200 million hectares.

Global food supplies doubled between 1950 and 1980 but grew by only 20 per cent from 1980 to 1990. It is estimated that food production will have to increase by 60 per cent in the next 30 years to keep the world population fed. As stated in *The A to Z of World Development* (Crump and Ellwood 1998), "Most HYV's have now reached their biological limits and experts are now touting a so-called 'Gene Revolution' as the next way of increasing global food production."

Solutions to irrigation issues already tested in many parts of the world include the following:

- More small-scale irrigation
- Rain-fed farming
- Restoration of critical watersheds to stabilize water cycles
- Research on salt-tolerant and drought-resistant strains of crops
- Flood-recession farming (an indigenous cultivation method that involves planting crops on river flood plains)
- Methods to store rainfall and set up percolation tanks
- Replenishment of groundwater
- Approval of only small dams—microscale catchments of water
- More investment in the Grameen Bank, which lends to small-scale entrepreneurs in Bangladesh, rather than the World Bank, which lends to foreign corporations to execute large dam projects

Teaching about irrigation pros and cons is a good way to initiate students' critical thinking about water issues.

Dam Building

Studying dam building is another excellent method to examine a belief system not purely based on scientific facts and applied engineering principles but, rather, driven by propaganda and distortion. Exploring the engineering myth of bringing progress to all by taming the rivers forever and subjugating their natural flow by damming technology is a good first step to becoming an informed global citizen on the water crisis, especially for young adults, who have long futures ahead of them. Immersion in different ideologies about water resources and how they should and could be used is a must for people of all ages and in all places. The challenge is enormous right now and worth every bit of time and effort.

The West has gone berserk with technocratic approaches and large engineering projects based on applied hard-sciences principles and driven by market demands. These demands are not necessarily the same as community needs; in fact, the two are most often diametrically opposed. In the process of dam building with a focus on the full industrial and agricultural use of water (in other words, full commercialization of fresh water), we may have lost our souls.

As the following statistics show, the world's dam building just decades ago had abruptly grown out of all proportion (Abramovitz 1996):

- In 1900, the world had only a few dams (all under 15 metres).
- In 1965, there were 5,270 high dams, two-thirds of which were in China.
- In 1985, 36,562 dams had been constructed, 18,820 in China alone.

Why are so many countries around the world—and their political, industrial and financial leaders—addicted to dam building? Dams have been called glorifying pet projects for dictators or for heads of state not democratically oriented. Why were so many dams built in such a short time span? To study dams critically, one must consider the heavy propaganda: the promotion of dams and the promise that dams would produce in the near future 1,001 wonderful things for all people and businesses, such as clean hydroelectric energy, potable water for people and endless supplies of fresh water for massive industrial projects. Dams were planned and designed in glorious detail to make visible the power of the builders and financiers.

In 1908, Winston Churchill (quoted in McNeill 2000, 149) stood near the northern shores of Lake Victoria, Uganda, and said, "So much power running to waste, . . . such a lever to control the natural forces of Africa ungripped, cannot but vex and stimulate the imagination. And what fun to make the immemorial Nile begin its journey by diving into a turbine."

Enormous dam-building campaigns were mounted by intensive lobbying groups including big financial corporations, engineers, politicians, and perhaps a few geologists here and there—but not including biologists, wildlife and earth-science specialists, or public-health experts. Political leaders in constant search of a visible and permanent monument to their power were very busy and fanatical about articulating the dam-building propaganda.

Lenin, F. D. Roosevelt, Nehru, Deng Xiaoping and a host of lesser figures saw water in much the same way and encouraged massive water projects in the U.S.S.R., the U.S., India and China. They did so because they lived in an age in which states and societies regarded adjustments to nature's hydrology

as a route to create greater power or prosperity, and they had unprecedented technological means at their disposal. Since 1859, hydraulic engineers and their political masters have reconfigured the planet's plumbing. They did so to accommodate the needs of an evolving economy but also for reasons of public health, geopolitics, pork-barrel politics and symbolic politics and, no doubt, to satisfy their vanity and playfulness. Getting water in the right amounts in the right places at the right times for whatever one wishes to do requires hydraulic engineering, one of humankind's oldest applied sciences. Several million dams, tube wells, canals, aqueducts and pipelines are required to divert water from the destinations gravity had in store for it. "It is amazing to look back at how many major physical changes were wrought in the hydrosphere after 1900: how we came to divert much of the world's fresh water from its previous paths and rhythms in order to achieve progress in our industrial revolution" (McNeill 2000, 150).

What the promoters of the dam-building schemes never told us about was the environmental impact. Rather than being deposited in the delta, all the good silt from rivers was suddenly trapped in the reservoir behind the dam. Farmers now had to apply pesticides and fertilizers to get a crop to grow at all. Look, for example, at the revealing reports on the Nasser Dam built on the Nile on a grandiose scale in 1959, which did some of the marvellous things promised but which also had a devastating impact overall: waterlogged land, salinity, schistosomiasis, nutrient-starved fields, an instant need for massive application of fertilizers and pesticides, a dying Mediterranean fishery and a total bill that was more than the total gains from the irrigation.

In fact, dams destroyed fishing and damaged agriculture by setting them up for new failures. The unannounced side effects were many, including artificially introduced flow alterations, earth tremors and the spread of new contagious diseases. However, the dams' worst impact was the displacement of whole communities: millions of people were declared disposable and removed without further ado or compensation. This resulted in massive human-rights violations, first in India and now in China. In India, the Narmada Valley project to build 30 large dams, 135 medium dams and 3,000 small dams, which began in the 1980s, displaced more than 100,000 people and flooded 40,000 hectares. In 1989, the displaced held one of the largest demonstrations ever. China is repeating India's Narmada Valley disaster by building a series of dams on the Yangtze. This is the ultimate in dam building and a horrific story about displacing people, destroying historic sites, flooding highly fertile areas of prime agricultural quality and submerging beautiful tourist attractions—all in the name of progress: irrigation and, therefore, massive food production for all. (For full disclosure of dam defects and collapses and a synopsis of dam-building outcomes from an environmental, community-development and budget perspective, consult the International Commission on Large Dams (ICOLD) reports, which are shocking and insightful and which often recommend complete decommissioning of dams to restore local communities, livelihoods and well-being. Reading these reports is one of the best ways to understand the ideology behind many big dam-building projects.)

Dams and diversions have exploited all the easy runoff. The statistics are alarming. Almost all the world's major rivers have been dammed, some at several locations. Of course, most of the benefits promised did not materialize.

Colonial powers often could use whole armies of cheap labourers to execute large dams as public works—for example, in the Punjab. At the end of the colonial period, many highly ambitious rulers jumped on these spectacular water projects to promote their own domestic and international agendas (for example, in modern India or Egypt) using energy-intensive technology when available and armies of labourers when needed. The apex of dam building and wetland drainage occurred during the Cold War, when the U.S. and the U.S.S.R. saw themselves locked in an economic and public-relations struggle in which water projects seemed most useful. As was often the case in 20th-century environmental history, political agendas accelerated the de-plumbing of the hydrosphere (McNeill 2000, 191).

Who Owns and Controls Water Resources?

At this moment in history, when all over the world whole regions are experiencing severe water shortages, the questions that come to mind are, How on earth is water disappearing? What causes droughts? Where does water come from? How much fresh water is there on this planet? What impact does globalization have on access to water?

At this same time, we discover that we are in the hands of big corporations that have already gained a monopoly over large quantities of fresh water in their relentless and ruthless pursuit of absolute and global control. They had plans ready to "help" communities all over the world during the sudden water shortage (see the chapters "Global Water Lords," "Emergent Water Cartel" and "Global Nexus" in Barlow and Clarke's [2002] study *Blue Gold: The Battle Against Corporate Theft of the World's Water*). What is their hidden agenda? Privatization is their strategy because now so much upgrading and repair work must be done to the water infrastructure. Water pipes need a major overhaul, which requires high-tech expertise and massive capital investment. This professional help is diplomatically "volunteered," at an opportune time, by water corporations. Their costly offer sounds like this: "We will take over for a while by contract and help you out of this water crisis forever. We will invest in your water infrastructure, and you will pay us for this long-term contract. Your access to water will be guaranteed, enhanced, updated and permanently secured."

Privatization has been taking place all over the globe. In the U.K., privatization on a grandiose scale was implemented under Thatcher with disastrous consequences. Higher prices were imposed unilaterally, blatant corruption appeared in top-level management and municipal delivery services were abruptly lost, resulting in a water system out of control.

Another alarming case of water privatization is South Africa. The new African National Congress (ANC) government came up with an excellent declaration of water rights for all called the Reconstruction and Development Programme (RDP): all households would have access to water and electricity. However, the ANC was beleaguered by the financial challenges of having no money in its budget to undertake massive repair work of the deteriorating water-supply infrastructure for the poorly equipped municipalities of the infamous black ghettoes. This infrastructure had been deliberately created and kept underdeveloped and deprived in the so-called homeland—a heavy burden inherited from the white apartheid regime. The cash-strapped government opened the door and let in the water transnationals, which immediately resulted in water management based on market-driven pricing. This led to an acute shortage of water for the poor and total cutoffs and house evictions whenever households failed to pay the skyrocketing water rates. The new government retained lock, stock and barrel the hydrological bias from the apartheid era. The water statistics for South Africa tell that story of complicity: 50 per cent of all water is used for white commercial farming, 25 per cent is used for mining and 12 per cent is used for households, more than half of which are white households (many with gardens and swimming pools).

Cochabamba, Bolivia, is another heartbreaking story of a local water crisis that was to be solved by instant privatization. The local community initiated a grassroots movement when it discovered that its water supply had been taken over by an American water cartel: Bechtel. The locals went to war in the streets for months to regain municipal control over access to and delivery of potable water. They won the bloody battle but lost the war. (See the chapter "Global Nexus" in Barlow and Clarke [2002] for the best first-hand report on this water war.)

Bulk sales in water are propelled by the same economic doctrine of privatization. Are bulk water sales a nightmare in the making or already a reality, designed to feed the voracious appetite of the global technology industry? What will the next move be? Shipment of water is based on selling water rights to the highest bidder while using oceans to haul fresh water from areas with a surplus to thirsty areas, thereby trying to undo the mistakes or accidents of geography. The argument is that sea-going water transfers could stimulate global water distribution. Water transfer in bags from Turkey to Cyprus and other Greek islands is marketed as innovation and progress. The Aquarius Company started this

transfer and already has a fleet of water bags in operation. At this very moment, water in bags, barges and other specially designed containers is being towed around somewhere on this planet. Certainly this is the case in the harbour of Piraeus (famous in ancient Greece and well known in the modern world of global shipping from where water as a commodity is delivered regularly to several Greek islands by ferry). All over the world, including Canada, schemes have been drawn up to transfer whole lakes, rivers and even icebergs. Even though so far these schemes have been rejected, they stubbornly reappear for renewed negotiation (Barlow 1999, 24–27). Could water-bag shipments become feasible on a more permanent basis for water-stressed countries? Is that an environmentally sound solution? The debate is far from over.

The bottled-water industry is another example. Who invented bottled water and why? How did we start accepting bottled water as a normal, everyday way of drinking water? Why do we carry around labelled bottles of water bought for an inflated price?

Should we just go with the flow of privatized water and find out the consequences later? Or should we start training various target groups to become water crusaders—fully alert and committed citizens of the globe?

Water-Resources Management

The year 2003 is the United Nations International Year of Freshwater, and that's what the March 2003 Third World Water Forum in Kyoto, Japan, was all about. At the World Summit on Sustainable Development, held in 2002 in Johannesburg, South Africa, a commitment was made to reduce by half the number of people without access to basic sanitation services, and the target date has been set for 2015. Will that target be reached?

The urgent call from all over the globe is to protect, rescue and safeguard for future generations the planet's freshwater resources. Monocultures, excessive and dangerously outdated irrigation practices, massive oil and gas extractions, and feedlot operations are depleting the water resources. This exploitation is analogous to spending our savings, including the interest, and living far beyond our means. At this point of overdevelopment, can we learn to live without oil and gas? Can we ever learn to live without water?

David Schindler (2003), a widely known and highly respected expert on water and an award-winning professor of biological sciences at the University of Alberta, gave Albertans a wake-up call in his recent article "High and Dry: Flushing Our Water down the Toilet." He writes, "We thoughtlessly use high quality water for irrigating, flushing toilets, injecting into deep wells for recovering oil and gas, washing away animal wastes and watering lawns, where poor quality water would suffice. In fact, it is not clear why we use a resource as scarce as prairie water for some of these practices at all" (p. 49). As he notes, "Even the notorious drought of the Dirty Thirties appears very mild when compared to some droughts in earlier centuries. In short, we are overdue for a granddaddy drought" (p. 48). He warns, "Drought will eventually put the lid on the so-called Alberta Advantage if we do nothing to improve our water management" (p. 51). Both Schindler and his colleague Bill Donahue have spoken on this issue at many recent public forums.

In water-resources management, surface water and groundwater are the most critical components in the hydrologic cycle. Groundwater is water that has percolated into the soil or rock, becoming trapped. In this permanent storage underground, water can be saved on a long-term basis for the future of all living creatures, including humanity. However, groundwater is used extensively and recklessly worldwide, which amounts to tapping into the source of "heritage" water meant for future generations. This is like dipping carelessly into our savings instead of planning carefully for the future. Groundwater is routinely used in more than half of the U.S.'s drinking water and satisfies 80 per cent of rural livestock needs. Globally, groundwater supplies are being depleted and polluted. Deforestation has been the culprit for a long time, speeding up the reduction of underground supplies of water. As a result, aquifers shrink and land subsides. In coastal areas, overexploitation of groundwater leads to the intrusion of salt water from the sea.

The behaviour of groundwater is fascinating: it moves very slowly

through the ground, in some places over a period of thousands of years. Groundwater was there millennia ago; therefore, it is called rightfully by its geological name, fossil water. Many chemicals sprayed or dumped decades ago have yet to filter into the underground supply. In Denmark, nitrate concentration in groundwater has tripled over the last 30 years as a result of fertilizers and manure. Pollution works like a time bomb ticking away in the groundwater. Groundwater is notoriously difficult to cleanse once it has been polluted: it contains no microorganisms and flows so slowly that the dilution or dispersal of contaminants is impossible.

> Overuse of groundwater is now widespread in China, India, Mexico, Thailand, the U.S., North Africa and the Middle East. Nonrenewable so-called fossil aquifers are being depleted at a rapidly increasing rate. Saudi Arabia mines fossil groundwater to meet 75 per cent of its water needs. In Beijing, the water tables have been dropping by 1–2 metres annually, and many wells have gone dry. In Mexico, the groundwater pumping exceeds the recharge by 50–80 per cent. (Crump and Ellwood 1998)

A lot can happen to water between falling as rain or snow and uniting with surface water or groundwater. Exactly what does or does not happen influences the quality, quantity and ecological health of our water. In the form of glaciers, rivers and raindrops, water carves, reduces mountains and erodes hillsides. All species of plants and animals are adapted to specific water conditions. If land use dramatically alters the amount of surface water or groundwater, or even alters the seasonal cycle of their availability, the abundance and distribution of species change.

Water Wars

Is there now a possibility of imminent wars triggered by the relentless and violent competition for access to water by several competing powers in many parts of the world? Will this result in control over water at gunpoint? Are we moving toward a third world war—over water?

Now is the time to focus on the freshwater crisis from local, provincial, national and global perspectives. Water has already moved to the front line of diplomatic schemes and war manoeuvres in the interest of countries that see accessing water as their top strategic priority. Where and when will we see wars over total control of water?

Several disputes over water are simmering or have already begun—many without being mentioned or characterized as water wars in the media. For example, the Nile has 10 countries disproportionately situated and not proportionately sharing the water. Iraq, Syria and Turkey are at loggerheads with each other over access to the waters of the Euphrates and Tigris Rivers. Turkey is located upstream and, therefore, is in total control. In Israel and Palestine, long-term Israeli greed has taken its toll on the water table. Israel "re-created" the desert and made it into a plantation, not a paradise, by forcing it to grow Jaffa oranges and cotton, which are not indigenous to that part of the world. Of Earth's river basins, 50–60 per cent are shared by more than one country. Only in 1997 was the Law of Non-Navigational Uses of International Watercourses adopted, but it has not yet been implemented.

Water wars are already going on, although they may be camouflaged and defined as ethnic conflicts. "Water wars are not a thing of the future. They already surround us, although they are not always recognizable as water wars" (Shiva 2002a, ix). Shiva continues, "These wars are both paradigm wars—conflicts over how we perceive and experience water—and traditional wars, fought with guns and grenades." Shiva juxtaposes a traditional culture of sacred water with a modern culture of commodification of water. She warns against covering up water conflicts with a different name and shows that the water wars in the Punjab and in Palestine are real and cannot be categorized as pure ethnic conflicts: "It is always possible to color water conflicts in such regions as conflicts amongst regions, religions, and ethnicities. In Punjab, an important component of conflicts that led to more than 15,000 deaths during the 1980's was an ongoing discord over sharing of the river waters" (p. xi). This conflict was described as a religious war or an issue of Sikh separatism. Similarly, the conflicts over natural resources between the Palestinians

and Israelis have been presented as primarily religious conflicts between Muslims and Jews.

Shiva's (1991) book *The Violence of the Green Revolution* explores in depth the ecology of terrorism. In a speech given at the World Social Forum 2002, Shiva (2002b) said,

> Destruction of resource rights and erosion of democratic control of natural resources, the economy, and means of production undermine cultural identity. . . . Economic globalisation is fueling economic insecurity, eroding cultural diversity and identity, and assaulting the political freedoms of citizens. It is providing fertile ground for the cultivation of fundamentalism and terrorism. Instead of integrating people, corporate globalization is tearing apart communities.

She continued, "Despite the rhetoric, this war [on terrorism] will not contain terrorism because it fails to address the roots of terrorism—economic insecurity, cultural subordination, and ecological dispossession."

Ursula Franklin (1997) has said that we, as democratic people, are in an economic war in which all roles have been reversed: the new enemy is us, the people. What used to be the commons—"the collectivity of ordinary people and what they hold in common"—is being invaded and taken over by corporations. According to Franklin, we are almost under military-style occupation with a puppet government controlled by transnationals.

Call for Action

Water is a global issue and cannot be dealt with in isolation from other environmental and political concerns.

Who should control water? Water is a precious resource—and a nonrenewable one, even though various levels of government in Canada are acting as if water can be completely remade, recycled, pumped back where it was taken from and returned to its place of origin.

At this time in history, the water issues seem set to collide, as happened at the Third World Water Forum. A participating activist provided an insider's report on this showdown in which the water barons were confronted by water advocates from all over the world. The corporations adamantly claimed that water is just another valuable commodity to be traded freely on the global market. The community-based water activists claimed that water is a basic human and environmental right. This put two opposing camps on the international battlefield over water: nongovernmental organizations versus corporations, civil society versus transnationals. Who is losing and who is winning according to the short- and long-term timelines? People at the grassroots level cannot afford to lose this battle. We must stand up for our rights to our own watershed management. We are in the same boat, all of us together for the sake of a collective future.

The aboriginals in British Columbia were heavily represented at Kyoto's Third World Water Forum because they were recently involved in a major battle about access to their water resources. This happened in Canada, which defines itself as a developed country. Testimonials were delivered from many communities in despair. I heard first-hand the depressing news of privatization from South Africa.

Water-resources management is about community development resulting in community destruction. The challenge in the current water crisis is to restore the principle of the commons (that is, the common good). If not, the commons will be broken up into so-called shared private and public partnerships, which will eventually erode the commons completely. There are some alarming danger signs: from 1990 to 1997, 100 nonlocal private companies have been busy taking over water supplies in developing countries. As Shiva (2001) warns, undemocratic, purely economic systems with centralized control displace people from employment and livelihoods, and generate a culture of insecurity. The perspective of water control helps us to better understand what poverty and inequality entail for people at the bottom.

Alarm bells should be ringing all over Canada, too. There is no stopping the trade in water after privatization has been allowed, even when just getting in through the back door and on a small, innocent-seeming scale. Water is at great risk under the increasing threat of privatization.

Privatization of water has a catastrophic and domino effect. Bulk water sales, the bottled-water industry, water freebies to Pepsi Cola or to the oil and gas industry, including feedlot operations, are the

beginning of the end to water for life and sustenance. The commons must be reclaimed and safeguarded for future generations.

Both Postel and Shiva detail how in India water rights gradually evolved out of a given ecological context. Under British colonial rule, these community-based water rights that had worked so well for centuries were undermined. Dam building (or colonization of rivers) destroyed the traditional effective and beneficial community control and took water away from the people.

The global water crisis is ecological and cannot be solved by a market-driven strategy of free enterprise and competition. Shiva (2002a, 15), in *Water Wars: Privatization, Pollution and Profit,* effectively summarizes the "water for profit or for people?" issues: "The water crisis is an ecological crisis with commercial causes and no market solutions will work: in fact, they destroy the earth and aggravate inequality. The solution to an ecological crisis is ecological, and the solution for injustice is democracy. Ending the water crisis requires rejuvenating the ecological democracy."

Water-extraction technologies violate the water cycle and create scarcity at the same time. The World Bank has financed massive extractions of groundwater, driven by financial schemes with full participation from private companies. These schemes have rapidly depleted water resources. The power-driven technology of water withdrawal all over India ran the aquifers dry and created groundwater famine all over areas that had been water sufficient. This nontraditional, privatized and highly mechanized extraction of water proved catastrophic: wells run by fossil fuel and electricity mushroomed. Similarly, deep well digging was believed to be the best mechanism for developing pastoral regions in Africa but also had disastrous consequences. There is no surrogate for water, and lack of water results in drought, starvation, destitution, dehydration and death.

The ruthless and fast exploitation of natural resources is like a no-deposit, no-return method that considers the businessperson's perspectives and market interests, not the needs and well-being of the people.

Canadians are big water drinkers and users. We use more than any other country on the planet, except the Americans, who outdo us greatly and, moreover, want access to Canadian water through bulk sales. Do we have to share our water with others just because they are neighbours or trade partners? That has become a big question since the Free Trade Agreement.

Barlow (1999) points out that we do not need the World Trade Organization (WTO) to look after our water. What we need is an international water treaty organization with the power to legislate. We do not need more water forums for debating pros and cons; rather, we need a water parliament with a democratic process of engaging directly affected target groups. Water should be exempt from all so-called free-trade agreements because they make water a costly commodity. If we let the water corporations control water, we will pay world-market prices.

The World Bank's strategy of privatizing water and making it available for whatever price the market bears is not based on a humane vision. In fact, it bluntly states that the poor will get water welfare and all others will pay. The Free Trade Area of the Americas (FTAA) violates human dignity by increasing the concentration of water resources in a few powerful hands. This amounts to grabbing water rights and taking them away from the commons. Secure access to safe water is a human right. Let's reclaim water for the public.

Water should be regulated as a public trust. If it is sold on the open market, the human and sociopolitical costs are enormous. For the shantytowns and ghettos of the world, an extra barrier can block the poor off from water.

Water is critical both to natural and human systems, and this should be reflected in its central role in the environment. Progress can be revealed as an illusion when one looks critically at the outcomes. What defines progress? Shouldn't it be for the overall betterment of humanity?

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Enneke Lorberg is a volunteer and public-education coordinator with the Sombrilla Refugee Support Society in Edmonton, Alberta, and a passionate and vocal supporter of global water rights.

Water in Holland

Enneke Lorberg

My conversion to water activism took place at a 2001 Vancouver conference coordinated by the Council of Canadians. The conference was an eye-opener on multiple levels: Canada itself, representing the dispossessed and disadvantaged, 1,000 delegates representing grassroots communities from all over the globe. Delegates delivered testimonials about the alarming water conditions in the places in which they were trying to survive. Hearing about dam building, human-rights violations, feedlot operations and lack of water-safety standards was shocking and powerful for me. In fact, it empowered me to become a water crusader for life!

How on earth did I take water for granted for so long? Being married to a hydrogeologist for 30 years did not help, because I didn't listen to anything he said about groundwater. But it helps now that I have become a listener.

For a long time, I had little understanding of groundwater. I assumed that it was in the ground—that it had shown up there at some moment of its history or prehistory. And somehow, for some strange reason, it came from the kitchen tap if somebody turned the tap on. But was it groundwater, surface water, rainwater or all of the above running into the sink? I knew that manholes were for runoff water and that recycling was done in a big plant I had visited a long time ago, where clouds of steam rose from pools of water somewhat mysteriously, like near the temple of Delphi in Greece.

On the other hand, I knew a lot about water conservation because I was immersed in it as a child in the Netherlands. A limited supply of rainwater, stored in a big tank in the ground, came into our house through various water taps, which my parents guarded as if water were holy. Rainwater catchment has become a major global issue (see the insert on Sombrilla's presentations for schools, which illustrate how all Mayan households are set up for catching rain during the rainy season). As a child, I was trained to never, ever let the water tap run, and our house had no hot-water tap. Only much later did the hot-water tap come—as a technological breakthrough and with an enormous and boisterous celebration—into our house. After that, anybody caught running the hot water for longer than half a second would face loud and lively forms of excommunication.

This early childhood training had a great and permanent impact on me: any tap anywhere that has running water, especially hot water, becomes the immediate focus of my attention. Anybody who lets the hot water run gets the full load of my water-conservation ammunition—a battery of arguments for water preservation. This maybe proves that education does work on the mind and the heart if administered in the right doses, at the right time and in the right spirit. Water-conservation techniques must be taught to multiple target groups right now!

Like many Dutch people, I was born on a *terp*—a small, man-made mound built by prehistoric settlers in the lowlands in self-defence against the forever-returning sea floods. I learned about the role of weeping tiles in modern agriculture before I was 10 years old from watching my dad look after that agricultural practice and listening to his explanation. Water preservation was serious business for any modern farmer in the Netherlands who respected his own profession; therefore, this key concept was implemented with scientific precision and fanaticism.

I was also raised in the Dutch belief system that water is the enemy of the state, that the sea must be pushed back and fully controlled, that dykes must be reinforced and expanded at all times, that rivers must be straightened out and canalized. Dutch history is primarily the story of how the settlers in the lowlands were for two millennia

engaged in a constant battle to fight back the sea and rivers threatening their security. Building dykes and dams was the only sensible form of protection, and it became a constant preoccupation. Holland's various names reveal its nature: located under sea level, very low and shaped like a deep dish filled with land but surrounded by higher levels of water all along its coastline. Only because of its many dykes is Holland not submerged in water.

Straightening coastlines, pushing water where we want it and keeping oceans at bay are major components of the ideology that water must be kept under control at all times and at all cost. However, coastlines are the planet's most dynamic environments, and the damaging and long-lasting impact of these human activities can be seen around the North Sea and in Japan. The most ambitious in this area were the Dutch. In 1916 a storm surge spilled some of the North Sea onto the Zuiderzee (a large inlet in the central part of the Netherlands), and this flood triggered a chain reaction: the Dutch parliament decided to act on an earlier piece of legislation (passed in 1890) to seal off and drain the Zuiderzee. The Afsluitdyk (meaning "closing-off dyke") was built from 1920 to 1932. Then, more waterworks were planned and executed for about half a century, adding 14 per cent more polders (low-lying land reclaimed from the sea), creating a new freshwater lake and shortening the coastline by 300 kilometres.[1]

For the Dutch, water was the enemy, and the constant goal was to reclaim more land from the enemy—especially after the disastrous flood of 1953 in the southwestern province of Zeeland (meaning "sea land"), where many dykes broke and hundreds of people drowned. That national disaster spurred the Dutch to design and execute more gigantic dam and dyke projects. The coastline would be straightened out once and for all, all inlets and bays would be filled with dams and more polders were planned.

The polders formed several components of the comprehensive and complex engineering project called the Zuiderzeewerken, or the Zuiderzee Works. For quite a while, the Zuiderzeewerken and the polders were the national pride, based on sophisticated water-engineering designs that made the Dutch feel they were at the cutting edge—until one morning they woke to the harsh reality of environmental impact and catastrophic damage: no more frogs were croaking in Holland!

Right then and there, the Dutch changed their approach to water management and became committed to protecting the environment with great passion and almost religious fervour. A nation reoriented itself and started building and adopting a radically different ideology of water, now embedded in a comprehensive and progressive environmental policy. The environment is now the top priority, and water is safeguarded in a radical, comprehensive and systemic manner. The last planned polder instead became a beautiful bird sanctuary, and many other wetland areas are being restored continuously. This reversal in ideology is a unique process of collective critical rethinking that had a revitalizing impact on the Dutch national identity. Suddenly, the Dutch were all singing from the same hymn book: the environmental one.

Critically studying your own country's and province's ideology of water management is crucial. It may not be too late if you start right now!

Note

1. Japan also indulged in this type of massive land reclamation: 40 per cent of Tokyo stood on man-made land and the Tokyo Bay shrank by one-fifth. Globally, the land taken back from the sea added up to 500,000 square kilometres.

Build Your Own Fish

Scott Millar

It's February, and the only way to show a fish to a group of 8- to 12-year-old Junior Forest Wardens is to bring a cellophane-wrapped trout from the local supermarket or build a fish from scratch.

Intended as an introduction to fish and the science of a fisheries biologist, this mid-winter exercise was designed to allow me to describe the parts and functions of a fish. Provided with construction paper and art supplies, the students were to build each part of the fish as we discussed it. At the end of the discussion, they would assemble the separate parts to form a complete fish.

The obvious starting point was the fish's head. We discussed the shapes of fish heads we had seen and some of the reasons for the shapes. For instance, the northern pike has a streamlined head with a large mouth and forward-facing eyes, both of which are useful in its role as a predator. The sturgeon has a large "nose" with several barbels hanging just in front of its mouth, which is flat to the bottom of its head with large extendable lips. This shape allows the sturgeon to feel its way around in dark, murky water and find food, which it can vacuum up with its mouth and lips. I finished the discussion on fish heads by having the students design heads for the fish, making the shape correspond to whatever function they wanted the fish head to have.

We then discussed the shapes and functions of fish bodies, tails and fins, using examples from fish with which we were all familiar. After discussing each part, we built it for our fish.

The products were ingenious and often creative. Some fish had several sets of fins or large circular tails. The offbeat fish designs included large, toothy mouths and adaptations akin to mechanical transformers. But, true to our original intent, each creation was built with a function in mind. The shapes of heads, tails, bodies and fins were all fashioned around the purpose of the part.

Life Cycle of a Fish

With some time remaining in our February fish workshop, I briefly described the stages in a fish's life cycle. We discussed spawning and how and why fish select their spawning habitat. Our discussion drew information from the experiences of all the students. The northern pike uses vegetation along stream and lake shores to suspend its eggs off the bottom and protect them from predators. The rainbow trout digs a hole, called a redd, in the stream bottom and buries its eggs in the loose gravel. It became clear that different fish species use many different methods and habitats to ensure reproductive success, and that the abundance and quality of the aquatic habitat are very important to a species' overall success.

Of course, the other stages of a fish's life cycle are equally important. Fish rearing, the growth of a fish from a newly hatched fry to an adult, is also a critical phase because young fish are prone to predation by other fish, birds and frogs. Many young fish select habitats that will protect them from predators. For example, vegetation is important for young northern pike, whereas the space amongst large rocks on the river bottom is critical for rainbow trout.

Two life stages occur when fish are adults: feeding and overwintering. Of course, food is important to every living thing, and we discussed where fish find food. Once again, the importance of a fish's habitat became clear.

But even more critical is an adult fish's requirement for a place to overwinter. We talked about what a fish does when streams are covered with ice and decided that, to survive Alberta winters, a fish needs deep water in pools.

To wrap up our discussion, the Junior Forest Wardens drew life cycles for their fish, keeping in mind the four main stages and having the

fish use key habitat features to protect them from predators and provide the requirements for the fish's life. The results were amazing. In the end, we had fish that spawned in trees or in lava, keeping their eggs and young safe from predators. In the space of a two-hour period, we had discussed the parts of a fish and then built a complete fish from the separate parts we had designed, discussed the life stages of a fish and the role of its habitat, and designed a unique life cycle for our newly built fish.

Assessing Fish Habitat

Our second session, designed to illustrate what fisheries biologists do when assessing fish populations and fish habitat, occurred in May on a spring day along a flowing stream in Edmonton, Alberta.

We hiked down the Mill Creek Ravine until we came to a scenic little oxbow in the creek channel. We discussed two ways to assess the fishery in the creek before the students set off in pairs to map the important features of the stream.

A main method for assessing the fishery in a stream is to catch fish to see what species inhabit the area, how many there are and where they occur. The students suggested several ways to catch fish, including angling and netting. But, in most cases, fish biologists catch fish using electrofishing—using specialized gear to pass an electric current through the water. The current temporarily stuns the fish, allowing them to be captured. The recovered fish can then be released back into the stream.

The information gathered from each fish includes its length and weight, which reveal the health of the fish and the fish population. The numbers of males and of females also indicate the population's health. Fish do not always need a one-to-one ratio of males to females, but the lack of one sex can harm a fish population.

The second assessment method we discussed involved looking at the attributes of the fish habitat. Members of our group suggested several attributes of the stream that they thought were important to fish, including the quality of the water and whether bugs were available for food. Other important habitat features were the depth and speed of the stream, the stream substrate and whether it would provide food and a place to hide, and the availability of vegetation or woody debris for cover.

Following our discussion of fish habitat, pairs of students set off to map a portion of the stream. On their maps, they were to show the stream channel and the direction of flow and then illustrate the areas where important fish-habitat features occurred. Overall, our group mapped a 200-metre section of the stream. When we were done, we had a relatively complete picture of the deepest portions of the stream, the areas where the banks were undercut, where the shrubs overhung the stream, and where sticks and logs provided cover.

Effects of a Project

Very briefly, at the end of our outdoor fish-habitat assessment, we talked about the effects of a project on fish habitat. We chose to look at the effects of a bridge crossing in our mapped section of the stream.

There are typically four main impacts related to the development of a project such as a bridge:

- Fish habitat can be lost to in-stream structures like bridge piers or altered when the substrate or stream banks are affected by construction.
- Construction can introduce sediment into the stream, which may affect the quality of the water and the fish habitat.
- The construction or the project may block the stream and not allow fish to migrate past the blockage. Depending on the timing, blockage of fish movements can be very detrimental to the fish population.
- Fish mortality may occur as the result of work in-stream.

When aquatic biologists assess a development project, they review its impacts on the fish and fish habitat and then try to mitigate each effect by altering the project's design or methods.

Climate Change and Fish

Climate change will have a substantial effect on the freshwater fish populations in Alberta and throughout the world. Changing patterns of rainfall and snowfall and variations in seasonal temperatures have already begun to affect the amount of water in our stream, rivers and lakes.

In places where rainfall and runoff have increased, high water

levels are allowing fish access to habitat not previously available. However, in areas of decreased runoff and lower water levels, streams and rivers will not be able to support their resident fish populations. Water quality and habitat availability will decline, and fish populations will quickly follow.

The effects of climate change on fish are complex, affected not only by changes in climate variables like rainfall, snowfall and temperature change but also by the timing of these changes throughout the year. Summer flow changes and temperature changes have different effects on fish than do fall or winter changes.

It is important to get people thinking and talking about our fisheries, the importance of fish habitat and the effects of climate change. Perhaps with increased awareness and understanding, we can begin to effect positive changes, changes more likely to preserve and protect the unique aquatic resources we already enjoy.

Scott Millar is a professional aquatic biologist with Mainstream Aquatics Ltd. in Edmonton, Alberta. He can be reached at samillar@telusplanet.net.

Bicycle Traffic Safety and Children

John Collier

As an instructor, I am asked by parents to teach their children how to cycle safely. At the end of the course, parents will often ask their child to show them a right- or left-turn signal, and if the child does so, the parents are happy. However, knowing turning signals is only a small part of bicycle traffic safety: other elements are much more important.

The whole notion of children cycling in traffic by themselves is flawed. Children shouldn't cycle unsupervised. The minimum age for driving a motor vehicle is not determined by when a person can reach the pedals and see over the steering wheel. It is set at the age when a young adult has the mental ability to drive a vehicle in a potentially complex traffic situation. Young children do not have this ability—period. The age at which children can hold a complex traffic pattern in their mind varies from 10 to 14 years old, depending on the child's maturity. A child should always be supervised by a responsible person when cycling on the road, even on a quiet residential street. Drivers of both motor vehicles and bicycles tend to relax on residential streets; as a result, residential streets have a much higher accident rate per kilometre of vehicle travel than do busy roadways.

Does this mean we should postpone teaching bicycle traffic safety until children are older? No! Children start learning traffic safety in the stroller. They are always watching what we do and will pattern their behaviour after ours. So, the first thing to remember in teaching traffic safety is to lead by example. After that, the first three basic traffic skills to teach children are to

- be consistent and predictable,
- be aware of their surroundings and
- communicate their intentions.

Be Consistent and Predictable

The most important skill in bicycle traffic safety is to be consistent and predictable. Other road users must be able to easily plan their own movements while accommodating the cyclist's. A consistent and predictable cyclist travels in a straight line, with little wobbling and no wandering, one metre to half a metre from the edge of the road. The cyclist should not be positioned right at the edge of the road, because any obstacle encountered, such as road debris or potholes, will then force the cyclist to turn *into* traffic to avoid the obstacle. If the cyclist is one metre to a half-metre from the edge of the road, depending on road conditions, he or she will be able to avoid obstacles by turning toward the edge of the road, *away* from traffic.

It is easy to teach a child to cycle in a straight line. The child can practise using a chalk line on a quiet road or in an empty parking lot as a guide. Teach the child to use a gear that allows medium to fast pedalling, because slow pedalling causes a cyclist to sway from side to side. Have the child look ahead to where he or she is going, because a cyclist looking at the front wheel will sway while micromanaging the bicycle's steering. Looking ahead also keeps the cyclist aware of what is coming, making it easier to plan his or her movements in traffic.

Be Aware of the Surroundings

Next, it is critical that a cyclist be aware of the surroundings. Looking ahead is no problem, but a cyclist must learn to look behind as well, while still being consistent and predictable. Looking behind involves shoulder checking. Practice will help a child learn to shoulder check while maintaining a straight line. Use the chalk line to help the child practise shoulder checking without wandering, and be sure to practise checking both to the left and to the right. Stand well behind the child,

hold your arms up or down and have the child tell you where your arms are. This will force the child to have a careful look. Children with poor peripheral vision will need to put one hand on their hip and turn their head right around to see clearly.

Communicate Intentions

Finally, a cyclist must be able to communicate his or her intentions. (So, we have finally got around to signalling!) This skill is noted last for a good reason: it is far more important that cyclists be predictable and aware of their surroundings than that they use signals. If the children and adults I have taught *never* signalled but always cycled consistently, were aware of their surroundings and acted accordingly, I would be very happy. This is not to say that signalling is a bad idea, but it is the least important of the skills—and the first discarded in difficult situations. This is also why bicycle educators are so annoyed by most so-called safe-cycling literature, which shows an outline of a cyclist looking straight ahead while making the approved signals—as if signals are some sort of magic incantation to ward off all other vehicles!

Also, I do not teach the approved signals, which were developed for use by motor-vehicle drivers. The signals are all made with the left hand because you cannot see the right hand of the car or truck driver and the right hand of a motorcycle driver is busy with the throttle. Despite the origin of the hand signals, most vehicle operators are not familiar with them and tend to misinterpret the approved right-hand turn signal (the left arm extended and bent straight up at the elbow) as either a left-turn signal or a wave. Children often confuse the two turn signals and will sometimes indicate a left turn with the right arm extended and bent straight up at the elbow.

Fortunately, cyclists, unlike other vehicle drivers, are free to use either arm. The best way to signal is the simplest: point where you want to go. Point with the left arm extended to go left and with the right arm extended to go right. This is easy to remember and, more importantly, easy for other vehicle drivers to understand.

Start teaching signals by having the child practise riding one-handed until comfortable riding with either hand off the handlebars. It is important to maintain a straight line while doing this. Some children's bikes have unstable steering geometry, and it may be difficult for the child to maintain a straight line while riding one-handed. Try another bike if this happens. Next, progress to full signals with the arm fully extended horizontally. Finally, practise all the skills together by having the child ride in a straight line, shoulder check, signal, shoulder check again and then turn.

Many of you will have noticed that I have not mentioned teaching the brake signal. Teaching children to stop with one hand off the handlebars is so dangerous that I find it difficult to fathom why it is so prominent in all the aforementioned "safe"-cycling literature. A bicycle is not wide and can easily be seen past, so the reason the cyclist is stopping should be readily apparent to all other vehicle drivers, making a signal unnecessary. To ensure a safe stop, the cyclist should keep both hands on the handlebars while braking.

Have I covered everything? Not in this brief article. But I have noted some of the basic skills not covered in children's "safe"-cycling programs, such as Pedal Pushers. In combination with responsible supervision, teaching children to be consistent and predictable, to be aware of their surroundings and to clearly communicate their intentions will allow them to cycle safely in and around the neighbourhood. Remember, if you would not toss your car keys to your seven-year-old, neither should you leave him or her to cycle alone.

John Collier has been a commuter cyclist for more years than he would care to confess to. He is also a certificated CAN-BIKE instructor and is involved in improving the cycling environment in Edmonton, Alberta.

Seasons

Janis R. Dearman

Spring

Dogwoods, redbuds, rustle lacy
finery,
Petticoats of young girls playing hide
and seek
Beneath the pines and hardwoods.
One rushes into the wind,
Arms flung wide, turns the mouth
toward heaven,
Tasting the sweet spring rain.
Possibility, promise, what may be.
One sheds the pall—winter's gloom
and doubt,
Freeing the soul to dream.

Summer

Willows stoop at water's edge,
Fingers tracing clouds in mirror of
the sky.
Breezes whisk away summer's breath.
Preparation, productivity—master
ant reserves
His store, setting dirt-smudged toes
to dancing
With lissome blades of grass.
First fruits, lush and full,
Dangle in the sun—joy, rejoicing,
love, labour,
Warm brown bodies 'neath azure
sky.

Fall

Proud oaks stand tall, broad,
Shoulders massive armatures for
gold-leafed sculpture—timeless
Masterpieces, testament of divine
artistry.
Security, substance—promise of what
Was, what is, what will remain,
to shade
And shield, harbour and heal.
Deep roots, noble girth, arms
Raised in praise to heaven.
One rests on
Trust, midst golden promissory notes.

Winter

Bare-boned hardwoods—grace
and beauty
Strength to weather winter's storms,
with icy branches
Bending, crackling under heavy snow.
Former glory's sweet remembrance
fades
With form's perfected lines—
Artist's sketch, divine perfection
Inked against the winter sky.
Winter's anthem sung with whispers
Crescendos into choral ode to hope
and promise—
Gift to come—eternal spring.

Janis R. Dearman is a hobby writer living in Greeneville, Tennessee, who does freelance secretarial and desktop-publishing work and some substitute teaching, and who has received a small bit of recognition for her writing efforts. Growing up in the mountains along the Tennessee River, she became a lover of nature, especially trees, which always seem to play an important role in her writing.

Photo by Louella Cronkhite

Resource Feature

What Kind of World . . .?

Do you think your Grades 4–8 students should know more about global issues? The United Nations Association in Canada's (UNAC) school program can help!

What Kind of World . . .? is an educational program designed to teach elementary and junior high students about the United Nations system and international issues from a Canadian perspective. It links local and global issues and highlights Canada's role in the UN. The program contains three one-hour lessons and is complemented by a comprehensive facilitator's package for use by teachers or trained volunteers. Learn more about the program at www.unac.org/learn/.

For more information, to invite a facilitator to your school or to order a facilitator's package, contact the program's Alberta regional coordinator, Evgenia Stoyanova, phone (780) 415-6276, e-mail nia_stoyan@hotmail.com, website www.edmonton.unac.org.

What Kind of World . . .? has been developed and implemented by UNAC with the generous assistance of the Canadian International Development Agency (CIDA).

Environmental Signals: Help for Teachers

Environment Canada has released two new reports: *Environmental Signals: Headline Indicators 2003* and its companion document *Environmental Signals: Canada's National Environmental Indicator Series 2003.* These documents indicate an ongoing effort to provide Canadians with credible, relevant and understandable information on the environment.

With the release of *Tracking Key Environmental Issues* in 2000, the government renewed its commitment to provide Canadians with easily accessible information about the state of the environment. The *Environmental Signals* reports continue to build on this effort, improving the indicators reported on, filling information gaps and developing new tools to make science-based trend information more accessible.

The reports are a snapshot of where we are now with respect to environmental indicators and reporting. At the same time, Environment Canada has embarked on the Knowledge in the Service of Canadians (KISC) agenda. As it moves forward with the aim of further improving the relevance of environmental information, Environment Canada would appreciate your feedback on the *Environmental Signals* publications and suggestions for achieving a vision of comprehensive, effective and integrated information systems.

Headline Indicators 2003 provides an overview of the key trends representing Canada's major environmental issues. For each area, it highlights what's happening, federal government actions and everyday tips for reducing environmental impacts. This report provides the latest information in the areas of water, air, climate, the ozone layer, biodiversity, toxic emissions and waste.

Canada's National Environmental Indicator Series 2003 provides a more in-depth look at the issues highlighted in *Headline Indicators 2003.* It includes additional indicators for each issue, more background, interpretation, descriptions of key government initiatives and remaining challenges. It discusses the links between the issues and the fundamental drivers of environmental stress. The report replaces the bulletins previously published as part of the series and provides indicator coverage in new areas.

The reports are available at www.ec.gc.ca/soer-ree. To order printed copies (French or English) contact the Environment Canada Inquiry Centre, 351 St. Joseph Boulevard, Gatineau, QC K1A 0H3; phone (819) 997-2800 or 1-800-668-6767; fax (819) 953-2225; TTY (819) 994-0736; e-mail Enviroinfo@ec.gc.ca.

For more information or to provide feedback, contact Risa B. Smith, Director, National Indicators and Reporting Office, Knowledge Integration Directorate, Environment Canada, 351 St. Joseph Boulevard, Gatineau, QC K1A 0H3; phone (819) 994-9570; e-mail Risa.Smith@ec.gc.ca.

Permission for Use of Photographs or Student Work

The Alberta Teachers' Association (ATA) requests the permission of parents/guardians for the reproduction of photographs depicting their children and/or the reproduction of work assignments completed by their children. The photograph/work will be reproduced in the Global, Environmental and Outdoor Education Council (GEOEC) newsletter, *Connections*, and is intended for teacher professional development.

Name of student _____

I, _____ **(printed name of parent/guardian of student), agree to the use of this photograph/work for the purpose stated above.**

Signature _____

Relationship to student _____

Address _____

_____ **Postal code** _____

We have recently begun posting archived issues of *Connections* on the GEOEC website (www.geoec.org/connections). Are you willing to have your child's written work posted on the Internet as well?

❑ Yes, I agree to have my child's written work posted on the GEOEC website.

❑ Yes, I agree to have my child's written work posted on the GEOEC website, using a first name only.

❑ No, I do not want my child's written work posted on the GEOEC website.

Please fax or mail forms to

Karen Virag
Publications Supervisor
The Alberta Teachers' Association
11010 142 Street NW
Edmonton T5N 2R1
Phone (780) 447-9491
Fax (780) 455-6481

The Alberta Teachers' Association

Global, Environmental & Outdoor Education Council

Mission Statement
To promote involvement in quality global, environmental and outdoor education

Objectives

- To provide a vehicle for Alberta teachers for professional development and communication in global, environmental and outdoor education
- To study and make professional recommendations about global, environmental and outdoor education issues
- To network with other provincial organizations that have similar concerns

Membership

- Regular member—Members of the Alberta Teachers' Association, as specified in ATA bylaws, are entitled to full privileges of council membership including the rights to vote and to hold office.
- Student member—Student members of the ATA are entitled to all benefits and services of council membership except the right to hold office.
- Affiliate member—Persons who are not ATA members as specified by ATA bylaws receive all the benefits and services of council membership except the rights to vote and to hold office.

Publications

- The GEOEC recognizes the wide range of interests among members and strives to foster the exchange of ideas and provide information and articles relating to the various components of the elementary and secondary curricula through publication of *Connections.*

Annual Conference

- The annual conference features a blend of activities, indoors and outdoors, ranging from hands-on workshops to social gatherings. All grade levels are represented in sessions. The emphasis is on practical information and application. The annual general meeting of the GEOEC is held in conjunction with the conference.

Executive

- Volunteer teachers are elected to serve on the GEOEC executive.
- Contact the president of the GEOEC through the ATA office if you are interested in running for a position.
- Elections take place at the annual general meeting during the conference.

Environmental Action Representatives (EARs)

- News to and from your provincial area is relayed through a person acting as a GEOEC representative for that school area.
- If you are interested in being an EAR for your school, please indicate so on your membership application.

Enviroshops

- Various activities and workshops organized by the Council
- Presentations in different locations around the province

JOIN NOW AND BECOME INVOLVED IN THE GLOBAL, ENVIRONMENTAL & OUTDOOR EDUCATION COUNCIL

Name _____ Alberta Teaching Certificate No. _____

Address _____ Postal Code _____

School or Employer _____ Grade Level/Specialty _____

❑ New Membership ❑ Renewal of Membership

❑ $25.00 Regular and Affiliate Membership ❑ $12.50 Student Membership

❑ $45.00 2-year membership ❑ $30.00 Subscription for nonmembers

❑ $65.00 3-year membership

I would be interested in serving as an Environmental Action Representative Yes ❑ No ❑

Make cheque payable to the Alberta Teachers' Association and mail it with the application to the Association at 11010 142 Street NW, Edmonton T5N 2R1.