DOES THE MANITOBA SCIENCE CURRICULUM
HELP TEACH TEENS TO BE MORE ENVIRONMENTALLY-MINDED?

Gabriel M. Kraljevic

A Thesis Submitted to the Faculty of Graduate Studies of
The University of Manitoba
In Partial Fulfillment of the Requirements
for the Degree of Master of Education

University of Manitoba
Faculty of Education
Department of Curriculum, Teaching and Learning

August 2011
© Gabriel M. Kraljevic
Abstract

The world is in the clutches of climate change. Species go extinct each day due to human activity. We are consuming non-renewable resources at an alarming rate. Sustainability, conservation and environmental stewardship have, arguably, never been more important. The Province of Manitoba does not have a specific high school course for environmental education. There are, however, related outcomes within the current science and social studies curricula. Has the curriculum created a populace with the necessary knowledge, attitudes and skills to begin to act for environmental change? In this mixed-method study I used surveys, focus group interviews with students, and one-on-one interviews with teachers to determine if grade 10 students are acting in positive ways toward the environment as a result of the science curriculum. In addition, do students and teachers perceive science to be the course most important in dealing with environmental education? In order to verify self-reported behaviours of students, an unobtrusive measure was devised to assess the recycling habits of grade 9 and 10 students. While students from both grades exhibited almost the same environmental knowledge and attitudes, the grade tens were more alarmed about the state of the environment and less naïve about their abilities to have individual impact. Although both groups reported several pro-environmental behaviours, neither group recycled materials after a luncheon.

Keywords: science curriculum, environmental education, attitudes, behaviour, teens
Acknowledgements

I would like to gratefully acknowledge my thesis committee who, in what became a very laboured project, provided me with exemplary support, patience and kindness. I was fortunate enough to have picked the best professors one could ask for. In particular I would like to thank Barbara for her encouragement, guidance and for convincing me to complete the thesis in the face of all the adversity that came my way. Her confidence in me often surpassed mine.

Thesis Committee:

Dr. Barbara McMillan (advisor), Faculty of Education

Dr. Robert Renaud, Faculty of Education

Dr. Terry Galloway, Faculty of Agricultural and Food Sciences

I would also like to acknowledge the support of the administration of the Seven Oaks School Division for their support throughout this thesis: the superintendents’ team, the Seven Oaks Educational Leave Committee and the school administrators.

I need to acknowledge all my teaching colleagues who sat in interviews, completed surveys, collected surveys and gave me unflagging support. In particular, I would like to mention Tammy Harder and Scott Poworoznyk for coming to my assistance at a crucial time and Roman Matwyczuk who was my critical friend in critical times.
Dedication

I dedicate this thesis to:

My parents, Marica and Ivan Kraljevic, for fostering in me a thirst for knowledge and an ethic of working to the best of my abilities. Thank you, Mama and Tata.

My sons, Christopher and Matthew, who had to be without their father many evenings and days throughout the years it took to complete this degree.

Most importantly, to my wonderful wife, Arlene, for her limitless support, encouragement and for having to bear the burden as I pursued my Master’s. I could not have done this without you.
# Table of Contents

Acknowledgements .................................................................................................................. i  
Dedication ................................................................................................................................ ii  
Table of Contents .................................................................................................................... iii  
List of Tables ........................................................................................................................... v  
List of Figures .......................................................................................................................... vi  
Introduction .............................................................................................................................. 3  
  Statement of the Problem ...................................................................................................... 4  
Literature Review ..................................................................................................................... 8  
  Environmental Education ...................................................................................................... 8  
  Successful Environmental Education .................................................................................... 11  
  EE and Pro-Environmental Behaviour .................................................................................. 12  
  Other Benefits of EE ............................................................................................................. 14  
  Science Curriculum and EE .................................................................................................. 14  
Research Methodology ............................................................................................................ 17  
  Overview ............................................................................................................................... 17  
  Participants and Research Instruments ................................................................................ 17  
    Student surveys .................................................................................................................. 17  
    Student focus group interviews ......................................................................................... 19  
    Unobtrusive measure of pro-environmental behaviour ..................................................... 19  
    Teacher surveys ............................................................................................................... 21  
    Teacher interviews ............................................................................................................ 23  
Results ..................................................................................................................................... 24  
  Students ................................................................................................................................ 24  
    Student surveys ............................................................................................................... 24  
    Unobtrusive measure of environmental behaviour .......................................................... 34  
  Teachers .................................................................................................................................. 35
Understanding environmental issues .......................................................... 36
Sources of pro-environmental behaviour ....................................................... 38
Where EE should be taught ........................................................................ 38
Science curriculum and EE ........................................................................ 39
Assessment of current science curriculum ................................................... 41
Discussion .................................................................................................... 43
The Impact of the Science Curriculum on Environmental Knowledge, Attitudes and Behaviours ............................................................ 43
General Sources of Environmental Knowledge .............................................. 45
School Curriculum and EE ......................................................................... 47
Errors and Limitations of the Study .............................................................. 49
Future Directions .......................................................................................... 51
Conclusion ................................................................................................... 56
References .................................................................................................... 58
Appendix A: Manitoba Science and Social Studies Outcomes Pertaining to EE .... 68
Appendix B: Student Environmental Attitude Survey ..................................... 70
Appendix C: Student Focus Group Interview Script ....................................... 75
Appendix D: Online Teacher Survey .............................................................. 76
Appendix E: Teacher Interview Script ............................................................ 85
Appendix F: Sample Parental Consent Form for Student Participants .............. 86
Appendix G: Sample Teacher Consent Form for Interviews ............................ 90
Appendix H: Ethics Approval Certificate ........................................................ 93
List of Tables

Table 1  Mean rating of self-reported, pro-environmental behaviours .......................... 24
Table 2  Students' mean scores on knowledge of key environmental terms .................... 26
Table 3  Student attitudes and opinions about the environment .................................. 28
Table 4  Sources of environmental knowledge reported by high school students .......... 31
Table 5  Sources of environmental knowledge: combinations of two responses .......... 32
Table 6  Sources of environmental knowledge: combinations of three responses ...... 32
Table 7  Courses that taught the most about environmental issues ............................ 34
Table 8  Environmental behaviour observed in high school students at a luncheon ......... 35
Table 9  Demographics of teacher respondents (N=51) ............................................ 36
Table 10 Average citizen's understanding of environmental issues ............................... 36
Table 11 Knowledge, attitudes and environmental behaviours of teens, rated by teachers .................................................................................................................................. 37
Table 12 Where teachers believe students learn how to help the environment ............ 38
Table 13 The curriculum that should be most important in teaching EE .................... 39
Table 14 The science curricula that should incorporate aspects of EE* ..................... 41
Table 15 Assessment of EE in current science curriculum ........................................... 42
List of Figures

Figure 1. Layout of choices for unobtrusive measure of environmental behaviour ....... 21

Figure 2. Item 7 from the Student Survey................................................................. 27
Introduction

The world is in the clutches of climate change (Intergovernmental Panel on Climate Change, 2010). Species go extinct each day due to human activity (Barnosky, et al., 2011; UNEP, 2010). We are consuming non-renewable resources at an alarming rate. Sustainability, conservation and environmental stewardship have, arguably, never been more important. How is it, with the level and quality of education we have in Canada, that our populace is still among the most wasteful on the planet? (Burck, Bals & Rossow, 2009; Winnipeg Free Press, 2006, Oct 26)

Environmental education (EE) is the pedagogical arena which specifically addresses these issues. In general, EE attempts to address five basic goals: to impart the necessary knowledge to understand environmental issues, to foster positive attitudes towards the environment and its safe-keeping, to promote a set of values or beliefs that we should be concerned about the environment, to develop the skills necessary for making informed decisions and, finally, to induce behaviours in people that help, not harm, the environment (UNESCO, 1978).

Traditionally, the school subjects of science and social studies have been most closely linked to EE (Kumler, 2011). The Province of Manitoba does not have a specific high school course for environmental education. There are, however, related outcomes within the current science and social studies curricula. It is important to know if the province fulfilled the growing need to ensure that our students are receiving adequate education in environmental issues.
Statement of the Problem

In the grade 10 (Senior 2) science curriculum, there is a unit entitled *Dynamics of Ecosystems* dedicated to conservation and ecology, but there are only two specific learning outcomes (SLO) that deal with human impact on ecosystems (Manitoba Education, Training and Youth, 2001):

*S2-1-10 Investigate how human activities affect an ecosystem and use the decision-making model to propose a course of action to enhance its sustainability*

*S2-1-02 Discuss factors that may disturb biogeochemical cycles. Include: natural events, human activities.*

One other SLO in this unit does not specifically state to include human impact, but it most certainly can:

*S2-1-07 Discuss the potential consequences of introducing new species and of species extinction to an ecosystem.*

Prior to this grade, students would have taken *Interactions with Ecosystems*, an environmentally-related science unit in grade 7, where the curriculum lists three outcomes that deal with human impact on ecosystems and one SLO (7-1-10) that could involve human impact (Manitoba Education, Training and Youth, 2000).

*7-1-05 Identify and describe positive and negative examples of human interventions that have an impact on ecological succession or the makeup of ecosystems.*

*7-1-06 Identify environmental, social, and economic factors that should be considered in the management and preservation of ecosystems.*
7-1-07 Propose a course of action to protect the habitat of a particular organism within an ecosystem.

7-1-10 Analyze, using ecological pyramids, the implications of the loss of producers and consumers to the transfer of energy within an ecosystem.

Grade 10 science is, for many students, the final science course they will take in the Manitoba public school system. In one representative high school, 100 of 192 grade 11 students were not enrolled in a science course in 2010 (Seven Oaks School Division, 2011). The only science course after grade 10 that includes environmental issues is Biology 40S (grade 12) which has three outcomes specifically related to human impact on biodiversity (Appendix A). Based on 2009 data, 32% of Manitoba students (4,800 of 15,200 total enrolment) took Biology 40S (Murray, 2011).

The final required course in social studies for a student in Manitoba is Canadian History 30S in grade 11 which, as expected, does not deal with the more geography-related topic of environmental issues. Thus, like science, the last social studies course a student in Manitoba must take that includes environmentally-related outcomes is Geography 20S in grade 10. This course, entitled Geographic Issues of the 21st Century, has 11 outcomes across the curriculum that directly address human impact on the environment, including three outcomes that delve into the impact of personal choices.

(See Appendix A for a comparison of curriculum outcomes.)

In response to the UNESCO Decade of Education for Sustainable Development, the province of Manitoba produced a resource for curriculum developers, teachers, and administrators that encouraged and provided direction for integrating sustainability concepts, skills, values, and life practices into new and existing curricula (Manitoba
Education and Training, 2000). The social studies curriculum in Manitoba has integrated a focus on sustainable development throughout the grades.

The Manitoba Science curriculum is built upon five foundations (Manitoba Education, 2011):

A. *Nature of Science and Technology*

B. *Science, Technology, Society, and Environment (STSE)*

C. *Scientific and Technological Skills and Attitudes*

D. *Essential Science Knowledge*

E. *Unifying Concepts*

Of particular interest in this study are foundations B and C, in which three overarching general learning outcomes (GLO) are listed:

B1. *Describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies and the environment, both locally and globally.*

B5. *Identify and demonstrate actions that promote a sustainable environment, society and economy, both locally and globally.*

C4. *Demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information.*

It is important to ascertain if the current Manitoba science curriculum is meeting these goals, directly-related to EE, by the time students leave grade 10. A fundamental question exists: Has the curriculum created a populace with the necessary knowledge, attitudes and skills to become agents of environmental change? More specifically, will
grade 10 students be ACTING in positive ways toward the environment, as specified in
general learning outcome B5?

While social studies and science are the curricula charged with teaching EE there
is no literature to examine what students and teachers perceive as being most important in
this regard.

Since Science 20F is the last science course a large portion of students will take in
their Kindergarten-Grade 12 education, to determine if the current Manitoba science
curriculum is meeting the challenges laid out above, I attempted to determine if the
following conditions existed:

- Grade 10 students who have completed the Dynamics of Ecosystems unit will
  self-report and exhibit more pro-environmental behaviours than grade 9
  students.

- Grade 9 and 10 students will perceive science as being the curriculum
  primarily responsible for teaching them about the environment and
  sustainability.

- Teachers will perceive the science curriculum as being primarily responsible
  for teaching students about environmental topics and sustainability.

Teens were the focus of this study rather than younger students for several
reasons: teens are at an age where they are becoming independent and are making, or are
in the process of making, conscious decisions about their life style, consumerism and
future career directions. In addition, because they are learning to drive and many start
part-time jobs, they are beginning to have the mobility and the means to act upon their
decisions.
Literature Review

Environmental Education

In the normal discourse of educators, the phrases ‘education about the environment,’ ‘education in the environment’ and ‘education for the environment’ seem to sum up the different approaches to environmental education that have co-evolved (Hungerford and Volk, 1990; Simmons and Volk, 2002; Palmer, 1998; Robottom, 1984). Education about the environment is characterized by a focus on the development of an understanding and knowledge of ecology, obtaining information about the environment and developing an awareness of environmental issues (Robottom, 1984). Education in the environment, (sometimes referred to as education from the environment) describes the EE approach in which natural settings become sources for enquiry and are used for first-hand discovery about issues in the environment (Palmer, 1998). When educating for the environment, there is an emphasis on developing an ethic in students which fosters desirable, pro-environmental behaviours (UNESCO, 1978). Many researchers stress that education for the environment is what defines EE and should be its primary guiding philosophy (Gralton, et al., 2004; Hungerford, 2002; Hungerford and Volk, 1990; Robottom, 1984; Simmons and Volk, 2002).

A number of EE researchers have simplified the basic goals of EE into three broad categories: knowledge, attitude and behaviour. Although the literature varies, it is generally accepted that the knowledge component of EE includes basic science, ecology, geology and historical perspectives required to understand the complexity of the environment and to raise awareness on environmental issues (Wilke, 1995). Knowledge
has long been held to be a key factor in improving pro-environmental attitudes (Campbell-Bradley, et al., 1999) and can be perceived as the fundamental requirement of every environmentally-responsible citizen (Shin, 1999). In more recent literature, the linear progression from environmental knowledge to positive attitudes to action has been challenged (Arvai, et al., 2004; Chawla and Cushing, 2007; Rickinson, 2001; Yan, 2004). Boeve-de Pauw and Van Petegem state:

The oldest and simplest models explaining the interconnectedness between environmental attitudes and behaviours were based on a linear progression from knowledge to attitudes, which led, in turn, to pro-environmental behaviour. These models were soon proven to be too simplistic, although they are still present in common wisdom. (2011, p. 3)

To clarify what is meant by ‘attitude’, Roth (1996) used the term “habits of mind” (p. 2) when discussing the development of positive environmental attitudes. In their study on attitudes toward science education in general, Raved and Assaraf’s (2011) used ‘attitude’ as a general term to encompass students’ “orientation or relation (be it positive or negative) towards a particular object or event” (p. 1221). Values and beliefs are believed to be a key component in the development of environmentally responsible people (Bogner, 1999), but the direct link between positive attitude to positive behavior may be more of a predictor than a direct causal relationship (Raved and Assaraf, 2011). Jimenez-Aleixandre and Pereiro-Munoz (2002) stated that students may learn attitudes which fit the expectations of the teacher. To create a life-long environmental ethos, they maintain that values education should be consciously incorporated into an EE programme.
Wilke (1995) stated, “students must develop reasoning and problem-solving skills that lead to responsible decision making and action” (p. 1). Thus, knowledge, attitudes and values are not enough to ensure successful EE – particularly if one expects the behaviours of the students to extend beyond the classroom or school (Jimenez-Aleixandre & Pereiro-Munoz, 2002).

In order to achieve the goal of a better environment, as Gralton, et al. (2004) have espoused, having students act environmentally responsibly and act towards improving the environment become the key. Fien (1997) considered this to be a limited, restrictive goal for EE and maintained that behaviouristic goals only work in the short term. In order to develop life-long changes in behaviour, EE should focus on developing critical thinking, reflection and actions skills. One of the early, influential environmental educators, Harold Hungerford, stated in a 2002 interview, “The targets toward which I wish to see learners moved are critical, reflective thinking and considered actions, rather than specific actions related to specific issues” (Simmons and Volk, 2002, p. 8). The importance of teaching students critical thinking in EE is repeated throughout the literature (Arvai, et al., 2004). Defining what critical thinking exactly means is difficult. Bailin (2002) maintained that educators need to move away from the traditional models of critical thinking as a skill or process. Instead, they should consider it to be a context-dependent, “good thinking” (p. 368) which is built upon requisite background knowledge and an understanding of the concepts, criteria and habits of mind related to the particular context. Applied to EE, this definition brings together the broad goals of knowledge, attitude and behaviour discussed thus far.
Successful Environmental Education

Hungerford and Volk (1990) laid out the guidelines for successful EE programs. They stated that, in order to help students become environmentally responsible citizens, an EE curriculum should include the following:

- Teaching environmentally significant ecological concepts and the environmental interrelationships within and among these concepts;
- Providing carefully designed and in-depth opportunities for learners to achieve some level of environmental sensitivity that will promote a desire to behave in responsible ways;
- Fostering teaching that results in an in-depth knowledge of issues;
- Teaching the skills of issue investigation and evaluation to learners as well as providing sufficient time for the application of these skills;
- Teaching learners the citizenship skills for devising solutions as well as providing sufficient time for the application of these skills;
- Attempting to develop an internal locus of control in learners; and
- Providing a wider scope and sequence that permits sophisticated issue investigation and resolution beyond the classroom.

Chawla and Cushing (2007) reported that the most effective EE programs are characterized by an extended duration of time, provide the participants opportunity to learn and practice action skills and are able to garner some success in achieving goals the students themselves value.

In a more critical view of EE, Blumstein and Saylan (2007) maintained that decades of EE have had little tangible or measureable results. They call for a radical
overhaul of curriculum which includes, among other recommendations, a focus on consumerism, promoting a world view of the environment, and an understanding of how government works. They also place a particular emphasis on critical thinking adding:

Environmentally aware citizens must be able to evaluate complex information and make decisions about things that we can’t currently envision. (Blumstein and Saylan, 2007, p.0975)

Blumstein and Shaylan’s pessimism may be well-founded. In a study of 100,000 grade 12 students in the US which spanned 30 years (1975 through 2005), Wray-Lake, et al. (2010) found a continual decline of students’ attitudes and pro-environmental behaviours since the 1980s. Furthermore, they reported a general decline in these students’ feelings of personal responsibility for the environment. Rather than making a personal effort to change their behaviours, the students foisted more of the responsibility for protecting the environment on the government and consumers.

**EE and Pro-Environmental Behaviour**

Zelezny (1999) conducted a meta-analysis comparing the impact of 18 classroom-based (traditional) and non-traditional EE programs on the environmental behaviours of participants. Although the programs differed widely in how they approached EE and the interventions used, there were some general tendencies. First, all the programs in which the participants were actively engaged in some form of environmental study had positive effects on reported and observed behaviours. This is well supported in the EE literature (e.g. Palmberg & Kuru, 2000) Conversely, programs which had no impact on behaviours were characterized by a lack of a participatory intervention (Zelezny, 1999). Another
conclusion Zelezny (1999) was able to make was that formal, classroom-based programs fared much better than informal EE programs. She also observed that classroom programs were longer in duration and that this may also have led to a difference between traditional and non-traditional EE programs. Ballantyne and Packer (2005), determined that, although limited, there is benefit from some informal EE programs when integrated with formal, classroom activities. Museums, field trips and exhibitions allow learners to explore more freely and construct knowledge much differently than in classrooms, particularly in allowing the participants to “engage with and in the environment [and] to observe the evidence and effects of environmental mismanagement.” (p. 290)

Dettmann-Easler and Pease (1999) reported that classes that attended residential EE programmes had developed more positive attitudes toward wildlife than in-class programs. This appears to refute Zelezny’s work, but the study parameters required that classrooms of students attend these environmental camps. Other forms of camps, such as church-sponsored and summer camps were excluded from the study. This restriction to school groups meant that the EE programmes were, in effect, part of a formal education programme. These authors also concluded that the immersion and length of the stay in the camps were likely contributors to success.

To summarize, an EE programme effective in changing behaviours has a number of recognized characteristics:

- It is a traditional, school-based programme (but may incorporate out-of-school experiences);
- It involves young people (under 18);
- It continues for a significant duration (typically over 10 hours); and
• It involves the participants actively in some outdoor study.

Other Benefits of EE

Ballantyne, et al. (2006) investigated the impact of EE programmes on the homes of students. They found approximately half of the students participating in school-based EE programmes take their message home – showing the potential for these programmes in changing attitudes and behaviours in the community. In Costa Rica, a study of elementary school students showed that the children were taking their knowledge home and teaching their parents. The parents, then, scored much better on conservation and natural history quizzes than a control group. (Vaughan, et al., 2003) Not only can EE increase the knowledge of participants, it also has the potential to improve the overall environmental knowledge of the community. (Rickinson, 2001)

There are also other tangible, non-environmental attitudes that may be affected by EE. Battersby (1999) reported that disaffected youth in British schools developed more positive attitudes to learning and school in general and that, as a result, their overall academic performance improved.

Science Curriculum and EE

In a recent study, Kumler (2011) compared social studies and science, courses most commonly linked to EE, and their ability to impact the ‘action repertoires’ of students with respect to sustainable land use. She found that the course in which students learn about environmental action had an impact and that science students demonstrated a lower action knowledge than social studies students. She attributed this to the compartmentalization of curriculum, particularly in the US, that presented a hurdle for
teachers. The prevalence of high-stakes testing prevents teachers from spending the time required to build these connections in order to focus on measurable outcomes specific to their curriculum.

For a Canadian perspective, Hart (2002) analyzed the incorporation of environmental education perspectives into the Pan-Canadian Science Curriculum document initiated in 1993. This document was a set of educational outcomes that provincial education departments could follow with the goal of creating a science curriculum common to all Canadians. Environmental education was incorporated chiefly through STSE (Science, Technology, Society and the Environment) outcomes. STSE outcomes are meant to be broader, encompassing goals which often include the dimension of attitudes. Hart (2002) conjectured that this inclusion of STSE has actually hindered EE because “environmental education crosses traditional disciplinary boundaries and involves underlying interests and attitudes innocent or even contrary to broad science issues related to social reproduction” (p. 1246). Similarly, Steele (2011) stated that science and EE are divergent and incompatible in many respects. Where science has traditionally been rooted in disseminating knowledge about the world in discrete disciplines, environmental education is based on debate and is inherently multidisciplinary. Stevenson (2007) also investigated this divide between science and EE and concluded:

Treating knowledge and its transmission as problematic [inquiry] creates a new definition of the role of the teacher and demands changes in the organisational conditions under which teachers generally work. If environmental education in its
contemporary form is ever to become a reality in schools, then these two issues must seriously be addressed. (p.151)

As with most aspects of education, there are many challenges that still face environmental education and many avenues for research.
Research Methodology

Overview

This study utilized a mixed-method approach that involved gathering data from both students and teachers to answer the research questions. In what Creswell (2009, p. 214) referred to as a concurrent embedded strategy, quantitative data were obtained from surveys, with focus group interviews, one-on-one interviews and an obtrusive measure providing qualitative perspectives. All surveys were anonymously completed and all individuals who were interviewed were volunteers.

Participants and Research Instruments

The students involved in this study came from a Winnipeg high school with an ethnically diverse population. Although the school would be considered primarily middleclass and suburban, a significant portion of the students come from rural homes, reserves and outside the catchment area.

Student surveys.

Grade 9 (N=96) and grade 10 (N=79) science students were surveyed on basic environmental knowledge, attitudes and behaviours [Appendix B]. Self-reporting of pro-environmental behaviours has long been used in environmental education research. The selection process involved the researcher making a brief presentation on the study in the grade 9 and grade 10 classrooms and asking for volunteers to complete take-home surveys. Students were instructed to answer the questions as honestly as possible, without consulting adults or other students. All surveys were returned anonymously.
Three grade 9 surveys were discarded for inappropriate and irrelevant answers (these are not counted in the total).

The student survey consisted of 15 questions:

- **Section 1:** Determined if the student was in grade 9 or 10.
- **Section 2:** To assess environmental behaviours, six Likert-scale items asked how often pro-environmental activities were conducted.
- **Section 3:** Eight Likert-scale items probed the student’s acquaintance with key terms and issues related to the environment to assess student knowledge.
- **Section 4 (Items 4 through 11):** These eight, Likert-scale items asked for opinions on the state of the environment and on human impact were designed to probe environmental attitudes. To determine if students were being truthful in answering the surveys, two items, #9 and #11, that asked the students to assess their ability to effect the environment positively, were worded slightly differently.
- **Section 5 (Items 12 and 13):** Asked students what their primary sources of information about the environment were and where they learned how to act environmentally responsibly. These were check boxes with a provision for write-in answers.
- **Section 6 (Items 14 and 15):** Two open-ended questions asked students to list what they considered to be positive and negative behaviours exhibited toward the environment.

Statistical analysis of some data included performing t-tests using GraphPad Software’s online calculator (http://www.graphpad.com/quickcalcs/ttest2.cfm).
**Student focus group interviews.**

Two focus groups, one for each grade, were assembled from volunteers who had indicated on the surveys they wished to participate in this phase of the study. The grade 9 focus group consisted of 14 students (9 male and 5 female), and the grade 10 focus group was made up of 10 students (4 female and 6 male).

The purpose of these focus group interviews was to probe pro-environmental behaviours and to determine where students believed they had learned the most about the environment. In particular, the school subject they considered most important in teaching them about pro-environmental behaviours was sought. The interviews were recorded on an MP3 recording device for later transcription by the researcher. See Appendix C for the basic script of interview questions.

**Unobtrusive measure of pro-environmental behaviour.**

The value and validity of self-reported behaviours has been debated in the EE literature (Chawla and Cushing, 2007; Kumler, 2011). In an attempt to link self-reported behaviours with actual pro-environmental action, a simple indicator was incorporated into the protocol.

The focus group interviews were held in conjunction with a pizza lunch. Unknown to the students, their choices of which type of plate, foamed plastic or paper; which type of cup, paper or plastic; and how they recycled the refuse were measured. The plate choices of the same diameter and cups of the same volume were offered. The plastic cups had a prominent and easily visible recycling symbol moulded into the bottom. A known number of plates and cups were arranged so as to be within easy and
equal reach of students (Figure 1). It was observed when the paper plates were first taken out of their packaging that they tended to stick together. Before setting out the paper plates, they were manually separated to avoid students accidentally grabbing more than one.

In order to provide an equal choice of how to dispose of the remains of the luncheon, one empty blue recycling bin and one empty black garbage bin of the same size and shape were located side-by-side in the room. The school where these interviews were held had a school-wide plastic and aluminum recycling programme, thus, it was felt students understood the difference between a garbage bin and a recycling bin, and were well acquainted with which materials were recyclable. After the lunch, the numbers of each item used and recycled were counted.

A measure of consumption, termed Usage, was calculated by dividing the number of plates or cups used by the number of participants. This was expressed as a percentage. Although these numbers were too small to make statistical analysis meaningful, they did provide an opportunity for discussion.
Teacher surveys.

An online survey was developed using the Form feature of Google Docs (http://www.google.com/google-d-s/forms/). The form was constructed to allow teachers to complete the survey anonymously, with results automatically tabulated in a Google Docs spreadsheet. The link to the survey was emailed to the teaching and administrative staffs of two school divisions and was open to teachers at all grade levels and administrators. By the end of the survey period of 8 weeks (April to June, 2011), 51
teachers had responded. The spreadsheet generated by the form utility in GoogleDocs was then exported to Microsoft Excel for further tabulation and analysis.

The survey consisted of 7 sections containing a total of 17 items [Appendix D]:

- **Section 1 (Item 1):** A check box question that queried which environmental activities were practiced in their school.
- **Section 2 (Items 2 through 4):** Three check box questions asked where teachers thought students learned about environmental issues.
- **Section 3 (Item 5):** A demographic question to determine which courses and grades the respondent had taught.
- **Section 4 (Items 6 through 8):** Three check box questions solicited which science curricula the respondent felt should include topics about EE.
- **Section 5 (Items 9 through 12):** Four Likert-scale questions rated environmental attitudes of students and the public.
- **Section 6 (Items 13 through 15):** Three Likert-scale questions rated EE in the Manitoba science curriculum.
- **Section 7 (Items 16 and 17):** Two open-ended questions allowed the respondent to suggest topics for science curriculum and to make general comments about science and EE.
- **All questions on this survey provided the respondent with an opportunity to make comments.**
**Teacher interviews.**

Volunteer teachers were interviewed and asked for their opinions on the importance of EE, where students learned about EE and about the Manitoba science curriculum. These were recorded on an MP3 device and transcribed by the researcher at a later date. A basic script for the interview can be found in Appendix E. In all, nine high school teachers were interviewed: five science teachers, three social studies teachers and one teacher who had taught both social and science. Teaching experience of the interviewees spanned from 2 to 30 years.

The transcripts of the student focus group interviews and the teacher interviews were not summarized in the results section with the quantitative data. Quotes and themes from these interviews were incorporated into the discussion of this thesis to help clarify or bolster the quantitative results.
Results

Students

Student surveys.

Self-reported behaviours.

Section 2 of the student survey asked students to indicate how often they performed basic pro-environmental tasks. The scale for this question spanned 5 time intervals, and the scores were 5 for a daily behaviour through to 0 for a behaviour that the student reported was never performed. The mean scores for their answers are summarized in Table 1.

For each of the 6 items in this question, there were no significant differences between the grade 9 and grade 10 respondents. The mean cumulative scores differed by 0.2 points, with a standard deviation of 5.5 for the grade 9 group and 4.5 for the grade 10. This indicates that there is, overall, very little difference between the two groups in their overall pro-environmental behaviours.

Table 1
Mean rating of self-reported, pro-environmental behaviours

<table>
<thead>
<tr>
<th>Grade</th>
<th>Recycle Paper</th>
<th>Recycle Aluminum</th>
<th>Recycle Plastic</th>
<th>Turn off Lights</th>
<th>Walk, Bike, Bus</th>
<th>Arrange Carpoools</th>
<th>Cumulative Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>9 *</td>
<td>3.9</td>
<td>3.6</td>
<td>4.0</td>
<td>4.2</td>
<td>3.9</td>
<td>2.2</td>
<td>21.8</td>
</tr>
<tr>
<td>10 **</td>
<td>4.1</td>
<td>3.6</td>
<td>4.0</td>
<td>4.4</td>
<td>3.3</td>
<td>2.5</td>
<td>22.0</td>
</tr>
</tbody>
</table>

Notes: Scoring scale used was 5=daily, 4=semi-weekly, 3=weekly, 2=monthly, 1=yearly, 0=never; *N=93; **N=79

The open-ended questions at the end of the survey were designed to probe the students’ environmental behaviours, both beneficial and detrimental.
Knowledge of environmental terms.

Table 2 summarizes the results from Section 3, which asked students to indicate how familiar they were with 8 terms associated with the environment. The 4-step scale of answers began at 0 for “I have not heard this term before” through to a score of 4 for “I definitely know what it means”.

For 7 of the 8 items there was very little difference (mean score differences between 0 and 0.3 points) between the grade 9 and grade 10 scores. In all cases where there was a difference in scores, the grade 10 group scored higher. The one term that showed the largest difference was “biodiversity” in which the grade 10 group scored 0.8 points higher than the grade 9 group.

The mean cumulative score for each grade was calculated. The grade 10 mean was 1.8 points higher than the grade 9 mean (p < .05).
Table 2  
Students' mean scores on knowledge of key environmental terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Grade</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 (N=93)</td>
<td>10 (N=79)</td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td>2.7</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>2.1</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Global Warming</td>
<td>2.7</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>Conservation</td>
<td>1.8</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Sustainability</td>
<td>1.4</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td>1.2</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Habitat Loss</td>
<td>2.2</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Alternative Energy</td>
<td>2.3</td>
<td>2.3</td>
<td></td>
</tr>
</tbody>
</table>

Mean Cumulative Score  16.42  18.23
SD  5.12  5.33

Note: Scores were assigned as follows: Not familiar = 0, Familiar but do not understand = 1, I believe I understand = 2, Definitely understand = 3; p < .05

Opinions and attitudes toward the environment.

Items numbered 4 through 11 on the student survey polled opinions on the extent the environment is in trouble, the importance of their understanding these troubles and their ability to have either a positive or negative impact on the environment (Table 3). An error was discovered in the order of the scale in question 7 on the survey, “Do you think that a change in the Earth’s environment is bad for YOU personally?” The question appeared on the survey as in Figure 2.
7) Do you think that a change in the Earth’s environment is bad for YOU, personally?

- Not bad for me at all
- Only slightly bad for me.
- It has no effect on me.
- It is very bad for me.
- It changes my life entirely.

Figure 2 Item 7 from the Student Survey.

The middle of the scale was intended to be the neutral answer – but “It has no effect on me” and “Not bad for me at all” both mean the same. However, “It has no effect on me” appears in the centre of the choices offered, so some respondents may have selected this as meaning neither bad nor good. This error made it difficult to interpret the answers accurately. This item was dropped from analysis.
Table 3  
*Student attitudes and opinions about the environment*

<table>
<thead>
<tr>
<th>Item</th>
<th>Response Selected</th>
<th>Grade 9*</th>
<th>Grade 10**</th>
</tr>
</thead>
<tbody>
<tr>
<td>4) How important is it for people to understand environmental issues?</td>
<td>Not Important</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>A Little Important</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Important</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Very Important</td>
<td>45%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Absolutely Important</td>
<td>37%</td>
<td>48%</td>
</tr>
<tr>
<td>5) How good an understanding of environmental issues do you think the average Manitoban has?</td>
<td>Don’t Understand</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Understand a Little</td>
<td>40%</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>Understand Enough</td>
<td>35%</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>Understand a Lot</td>
<td>19%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Fully Understand</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>6) Do you think the Earth’s environment is in trouble?</td>
<td>No trouble</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Minor Trouble</td>
<td>5%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>Some Trouble</td>
<td>38%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>A lot of Trouble</td>
<td>40%</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>Disaster</td>
<td>13%</td>
<td>16%</td>
</tr>
<tr>
<td>8) How would you rate YOUR understanding of environmental issues?</td>
<td>Don’t understand anything</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Understand a Little</td>
<td>15%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Understand Enough</td>
<td>37%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>Understand a Lot</td>
<td>35%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>Fully Understand</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>9) How would you rate YOUR ability to have a POSITIVE effect on the environment?</td>
<td>Can’t Help at all</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Only Help in a Small Way</td>
<td>21%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Some Positive Impact</td>
<td>30%</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>Can Help Many Ways</td>
<td>29%</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>A lot!</td>
<td>17%</td>
<td>12%</td>
</tr>
<tr>
<td>10) How would you rate YOUR ability to have a NEGATIVE effect on the environment?</td>
<td>Can’t Harm</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Only Hurt a Small Amount</td>
<td>31%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Some Negative</td>
<td>34%</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>Many Ways</td>
<td>13%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>A lot!</td>
<td>16%</td>
<td>12%</td>
</tr>
<tr>
<td>11) Do you believe that YOU can help improve the environment?</td>
<td>Can’t help at all</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Can help a little</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Can do something to help</td>
<td>35%</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td>Can do many things to help</td>
<td>24%</td>
<td>37%</td>
</tr>
<tr>
<td></td>
<td>Great help</td>
<td>29%</td>
<td>19%</td>
</tr>
</tbody>
</table>

*N=93; **N=79*
Knowledge, understanding of environmental issues (Items 4, 5 & 8).

Ninety-seven per cent of grade 9 students and 94% of grade 10 students responding to Item 4 thought it was at least “important” for people to understand environmental issues. Nearly half (48%) of the grade 10 students, however, believed that it was “absolutely important” while a little more than one third (36%) of grade 9 students selected “absolutely important”.

Although more than half of students in each grade thought that the average Manitoban had “enough” or better understanding of environmental issues (56% for grade 9 students, 63% for grade 10 students), there were substantially large numbers (40% of grade nines, 35% of grade tens) who selected the second option of Item 5. That is, that average Manitobans understood only “a little”.

The students believed that they were much more knowledgeable than the average Manitoban, as was evidenced by the 83% of grade 9 students and 89% of grade 10 students who personally rated themselves as having a good grasp of the issues.

State of the environment (Item 6).

The two groups of grade 9 and grade 10 students were in agreement that the Earth’s environment was in “some trouble”, “a lot of trouble”, or a “disaster” (91% and 89%, respectively.) The grade 10 students appeared to be slightly more alarmed as 13% more than the grade 9 students chose “A lot of trouble” or “Disaster”.

Personal impact on the environment (Items 9 through 11).

Based on Item 9, 42% of grade 9 students thought they could not help the environment or could only help in a small way. Twenty-six per cent of the grade 10
students, had a similar perception. In Item 11, which also asked about their ability to have a positive impact on the environment, there was a marked difference in responses: 12% of grade 9 students and 16% of grade 10 students believed they could not help improve the environment.

In response to Item 10, 63% of grade 9 students believed that they could have some negative to a major negative impact (“a lot”) on the environment. Eighty-five percent of grade 10 students held similar beliefs.

**Sources of environmental knowledge (Item 12).**

Table 4 is a summary of the general sources of environmental knowledge students identified as being most important. Students in both grades listed teachers and television most frequently: 56% of grade 9 students listed teachers; 65% listed television. In grade 10, these two sources were both selected by 63% of the students. Notable differences between the two grades occurred in their selections of websites (13% of grade 9 students versus 3% of the grade 10 students) and 15% of the grade 9 students listed Other sources where 3% of the grade 10 students listed alternatives to the choices in the question. In these Other sources which were written in, the students in grade 9 listed print materials, either magazines or books, most frequently. One student listed, UNESCO meetings. It was unclear what this student was referring to, but it may have been a teaching resource used by a previous teacher likely in middle school. One grade 10 student listed school. It was difficult to interpret this answer in the light of having teacher as a possible choice. The student may have been referring to the school environment, friends in school, or courses in school. There is also the possibility that he/she simply did not see teacher on the list.
Computer technology was, as an aggregate of the choices Facebook, Google, Websites, Wikipedia and Debate forums, checked off in 47% of grade 9 surveys and 37% of grade 10 surveys.

<table>
<thead>
<tr>
<th>Source</th>
<th>Grade 9 (N=93)</th>
<th>Grade 10 (N=79)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Environmental Clubs</td>
<td>8%</td>
<td>7</td>
</tr>
<tr>
<td>Facebook</td>
<td>10%</td>
<td>9</td>
</tr>
<tr>
<td>Field Trips</td>
<td>14%</td>
<td>13</td>
</tr>
<tr>
<td>Friends</td>
<td>6%</td>
<td>6</td>
</tr>
<tr>
<td>Google</td>
<td>17%</td>
<td>16</td>
</tr>
<tr>
<td>Parents</td>
<td>22%</td>
<td>20</td>
</tr>
<tr>
<td>Teachers</td>
<td>56%</td>
<td>52</td>
</tr>
<tr>
<td>TV</td>
<td>65%</td>
<td>60</td>
</tr>
<tr>
<td>Websites</td>
<td>13%</td>
<td>12</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>5%</td>
<td>5</td>
</tr>
<tr>
<td>Other:</td>
<td>15%</td>
<td>0</td>
</tr>
<tr>
<td>Common sense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debate forums</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Print material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siblings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNESCO meetings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word of mouth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The intent of this item was to solicit only one source of knowledge that the students thought to be the MOST important to them. However, 50% of the students (88 of 175) checked off more than one source. During the tabulation of the data, it was observed that several combinations of answers began to occur quite frequently. Table 5
lists the frequencies of the 6 most common combinations of two sources of environmental knowledge. *Teachers + TV* was, by far, the most frequent combination and occurred in 37% in grade 9 surveys and 35% in grade 10 surveys.

Several combinations of three sources of environmental knowledge were found to repeat themselves in the surveys (Table 6). The most common of these combinations was *Parents + Teachers + TV* which occurred in 14% of grade 9 surveys and the combination of *Google + Teachers + TV* occurred 13% of the time. For the grade tens the same combinations were the two most common, but the percentages were the reverse of the grade nines.

**Table 5**
*Sources of environmental knowledge: combinations of two responses*

<table>
<thead>
<tr>
<th>Response</th>
<th>Grade 9</th>
<th></th>
<th>Grade 10</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers and TV</td>
<td>37%</td>
<td>34</td>
<td>35%</td>
<td>28</td>
</tr>
<tr>
<td>Teachers and Parents</td>
<td>17%</td>
<td>16</td>
<td>14%</td>
<td>11</td>
</tr>
<tr>
<td>Parents and TV</td>
<td>16%</td>
<td>15</td>
<td>15%</td>
<td>12</td>
</tr>
<tr>
<td>TV and Google</td>
<td>15%</td>
<td>14</td>
<td>16%</td>
<td>13</td>
</tr>
<tr>
<td>Teachers and Google</td>
<td>14%</td>
<td>13</td>
<td>16%</td>
<td>13</td>
</tr>
<tr>
<td>Teachers and Field Trips</td>
<td>10%</td>
<td>9</td>
<td>14%</td>
<td>11</td>
</tr>
</tbody>
</table>

**Table 6**
*Sources of environmental knowledge: combinations of three responses.*

<table>
<thead>
<tr>
<th>Response</th>
<th>Grade 9</th>
<th></th>
<th>Grade 10</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents, Teachers, TV</td>
<td>14%</td>
<td>13</td>
<td>13%</td>
<td>10</td>
</tr>
<tr>
<td>Google, Teachers, TV</td>
<td>13%</td>
<td>12</td>
<td>14%</td>
<td>11</td>
</tr>
<tr>
<td>Field Trips, Teachers, TV</td>
<td>9%</td>
<td>8</td>
<td>10%</td>
<td>8</td>
</tr>
<tr>
<td>Facebook, Teachers, TV</td>
<td>6%</td>
<td>6</td>
<td>8%</td>
<td>6</td>
</tr>
<tr>
<td>Teachers, TV, Websites</td>
<td>6%</td>
<td>6</td>
<td>3%</td>
<td>2</td>
</tr>
<tr>
<td>Field Trips, Parents, TV</td>
<td>5%</td>
<td>5</td>
<td>5%</td>
<td>4</td>
</tr>
</tbody>
</table>
School courses important in EE (Item 13).

Item 13 on the student survey asked students to identify the school subjects that had taught them the most about environmental issues. Overwhelmingly, students in both grades indicated science as the primary source of this knowledge with social studies coming second (Table 7). As in the survey question on sources of environmental knowledge, this question was intended to solicit only one choice, but a number of students checked off more than one. Forty-seven per cent of grade 9 students and 56% of grade 10 students selected Science as their only answer. With respect to Social Studies, 19% of the participating students in grade 9 and 13% of those in grade 10 chose this course alone as their primary source about environmental issues. Of the students that checked off both science and social studies, 8% were in grade 9 and 16% were in grade 10).
Table 7
Courses that taught the most about environmental issues

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade 9 (N=93)</th>
<th>Grade 10 (N=79)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art*</td>
<td>1% 1</td>
<td>0% 0</td>
</tr>
<tr>
<td>English*</td>
<td>9% 8</td>
<td>6% 5</td>
</tr>
<tr>
<td>Math*</td>
<td>3% 3</td>
<td>0% 0</td>
</tr>
<tr>
<td>Phys.Ed.*</td>
<td>4% 4</td>
<td>1% 1</td>
</tr>
<tr>
<td>Science*</td>
<td>62% 58</td>
<td>82% 65</td>
</tr>
<tr>
<td>Social Studies*</td>
<td>28% 26</td>
<td>37% 29</td>
</tr>
<tr>
<td>ONLY Science</td>
<td>47% 44</td>
<td>56% 44</td>
</tr>
<tr>
<td>ONLY Social Studies</td>
<td>19% 18</td>
<td>13% 10</td>
</tr>
<tr>
<td>BOTH Science and Social</td>
<td>8% 7</td>
<td>16% 13</td>
</tr>
<tr>
<td>Other:*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Studies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* includes surveys with multiple answers

Unobtrusive measure of environmental behaviour.

The amounts of cups and plates used and recycled are summarized in Table 8.

The Usage, calculated by the number of items divided by the number of consumers, indicates that a high percentage of both groups chose environmentally-friendly paper plates over plastic. However, the students in both grades overwhelmingly chose plastic, made from a non-renewable resource, over paper cups. The Usage also indicated a degree of waste, particularly in the grade 10 students’ overuse of paper plates, where a few students used more than one plate during the lunch.

No items were placed in the recycling bin, even incorrectly. It was understandable that plastic plates were not recycled – neither the school nor the city-wide
recycling programme recycled foamed polystyrene. Paper recycling in the school was problematic in that there was a limited number of cardboard receptacles on the premises. Thus, paper recycling was not as pervasive as the plastic and aluminum programme which had blue recycling bins in all classrooms and permanent receptacles built into the student cafeteria. The plastic cups used in the luncheons had large, unmistakable recycling logos embossed into the bottom. It was expected that an environmentally-conscious student would have placed these cups into the recycling bins.

Table 8
Environmental behaviour observed in high school students at a luncheon

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Grade</th>
<th>Plates</th>
<th></th>
<th>Cups</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumed</td>
<td>9 *</td>
<td>13</td>
<td>93%</td>
<td>3</td>
<td>21%</td>
<td>13</td>
<td>93%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10 **</td>
<td>12</td>
<td>120%</td>
<td>2</td>
<td>20%</td>
<td>9</td>
<td>90%</td>
<td>1</td>
</tr>
<tr>
<td>Recycled</td>
<td>9 *</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10 **</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Usage totals over 100% indicated that more than one plate was used by some students. *N=14, **N=10

Teachers

The online teacher surveys were completed by 51 teachers. Based on the demographic questions, 55% of the respondents identified themselves as science teachers. Among those science teachers, 50% had high school experience, 32% worked in middle school (Grades 5-8) and 25% in early years (Kindergarten through Grade 4). Three respondents had taught across several grades and accounted for the total being over 100%. Within the high school science teachers, 93% had taught Science 20F (grade 10
science) in the last five years and 79% had taught Science 10F (grade 9). The remainder of the distribution can be seen in Table 9.

<table>
<thead>
<tr>
<th>Teaching area</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-science teachers</td>
<td>23</td>
<td>45%</td>
</tr>
<tr>
<td>Science teachers</td>
<td>28</td>
<td>55%</td>
</tr>
</tbody>
</table>

**Grade level breakdown of science teachers**

<table>
<thead>
<tr>
<th>Grade level breakdown</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Years School</td>
<td>7</td>
<td>25%</td>
</tr>
<tr>
<td>Middle School</td>
<td>9</td>
<td>32%</td>
</tr>
<tr>
<td>High School</td>
<td>14</td>
<td>50%</td>
</tr>
</tbody>
</table>

**High School Teacher breakdown**

<table>
<thead>
<tr>
<th>Grade level</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 10</td>
<td>13</td>
<td>93%</td>
</tr>
<tr>
<td>Grade 9</td>
<td>11</td>
<td>79%</td>
</tr>
<tr>
<td>Biology</td>
<td>9</td>
<td>64%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>7</td>
<td>50%</td>
</tr>
<tr>
<td>Physics</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Topics in Science</td>
<td>3</td>
<td>21%</td>
</tr>
</tbody>
</table>

*Note: * three teachers had taught across these grade levels, accounting for a total over 100%.

Understanding environmental issues.

With a mean score of 1.63 (SD 0.66), teachers in this survey felt that the public had a fair to poor understanding of environmental issues.

<table>
<thead>
<tr>
<th>Table 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average citizen's understanding of environmental issues</td>
</tr>
</tbody>
</table>
Much like their assessment of the general public, teachers rated teens as having a fair to poor understanding of environmental issues ($\bar{X} = 1.53$, SD 0.81) and also rated their treatment of the environment as being fair to poor ($\bar{X} = 1.61$, SD 0.57). Teens were rated as having a fair attitude towards the environment ($\bar{X} = 2.00$, SD 0.80). (See Table 11)

### Table 11

Knowledge, attitudes and environmental behaviours of teens, rated by teachers

<table>
<thead>
<tr>
<th>Response</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
<td>3</td>
<td>6%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Poor</td>
<td>25</td>
<td>49%</td>
<td>14</td>
<td>27%</td>
<td>22</td>
<td>43%</td>
</tr>
<tr>
<td>Fair</td>
<td>16</td>
<td>31%</td>
<td>25</td>
<td>49%</td>
<td>27</td>
<td>53%</td>
</tr>
<tr>
<td>Good</td>
<td>7</td>
<td>14%</td>
<td>10</td>
<td>20%</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>0%</td>
<td>2</td>
<td>4%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>No response</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1.53</td>
<td>2.00</td>
<td>1.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>0.81</td>
<td>0.80</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Very Poor=0, Poor=1, Fair=2, Good=3, Excellent=4
Sources of pro-environmental behaviour.

More than half (53%) of the teachers surveyed believed students learned the most about how to help the environment at school. A large portion (44%) of teachers believed students learned more about this outside of school with parents, environmental clubs and field trips listed as the top three sources of environmental information.

Examining the respondents of this question, the responses were distributed among the different groups (science, non-science, elementary, middle, high school) proportionally. No one group dominated any particular response.

Table 12
Where teachers believe students learn how to help the environment

<table>
<thead>
<tr>
<th>Source</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>27</td>
<td>53%</td>
</tr>
<tr>
<td>Parents</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>Field Trips</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>Environmental Clubs</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>Internet</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>TV</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Friends</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Facebook</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>2%</td>
</tr>
</tbody>
</table>

Where EE should be taught.

The majority of teachers (61%) believed that EE should be taught across all curricula. One respondent, who had declared that all curricula should be involved added, “Science mainly.” Another respondent who had also indicated that all curricula should
be incorporate EE commented, “I believe that the focus should be in Social Studies and Science.” Science was the second most selected with 14 of 51 respondents (27%). Of these respondents, four did not teach science. Social studies was selected by six teachers, four of whom taught science. No other curriculum was singled out as being most important in teaching EE (Table 13).

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Curricula</td>
<td>31</td>
<td>61%</td>
</tr>
<tr>
<td>Science</td>
<td>14</td>
<td>27%</td>
</tr>
<tr>
<td>Social Studies</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>Language Arts</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Math</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Science curriculum and EE.**

Three items on the survey asked the respondents to indicate which science curricula should teach facets of EE, namely: environmental awareness, sustainable development and how to act environmentally responsibly. It was clear the prevailing opinion is that these topics should be taught in all science curricula from Kindergarten to grade 12.

For those who selected specific curricula over a pan-science approach to EE, middle school science (grades 6 through 8) was selected more often than others. In particular, a larger proportion indicated that teaching middle school students how to act
environmentally responsibly was more important than teaching awareness or sustainable development (Table 14).

With respect to the specialized science courses in grade 11 and 12 (biology, chemistry and physics), only 1 or 2 teachers felt that these courses should teach environmental awareness or sustainable development. *Topics in Science* is a multidisciplinary course offered to grade 11 and 12 students, and many more respondents selected these courses as being suitable for teaching EE. No respondent selected biology, chemistry or physics as a curriculum to teach students how to act environmentally responsibly.

Two respondents, both middle school science teachers, indicated that EE should not be taught in science and added comments that it should be taught in social studies. Similarly, teachers who selected *Other* in the survey entered “social studies”.
Table 14
The science curricula that should incorporate aspects of EE*

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Environmental Awareness</th>
<th>Sustainable Development</th>
<th>Environmentally Responsible Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>K through 12</td>
<td>42</td>
<td>82%</td>
<td>41</td>
</tr>
<tr>
<td>K through 5</td>
<td>3</td>
<td>6%</td>
<td>2</td>
</tr>
<tr>
<td>6 through 8</td>
<td>9</td>
<td>18%</td>
<td>9</td>
</tr>
<tr>
<td>Science 10F</td>
<td>2</td>
<td>4%</td>
<td>4</td>
</tr>
<tr>
<td>Science 20F</td>
<td>4</td>
<td>8%</td>
<td>5</td>
</tr>
<tr>
<td>Biology 30S</td>
<td>1</td>
<td>2%</td>
<td>2</td>
</tr>
<tr>
<td>Biology 40S</td>
<td>1</td>
<td>2%</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 30S</td>
<td>0</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 40S</td>
<td>1</td>
<td>2%</td>
<td>1</td>
</tr>
<tr>
<td>Physics 30S</td>
<td>0</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>Physics 40S</td>
<td>0</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>Topics 30S</td>
<td>3</td>
<td>6%</td>
<td>5</td>
</tr>
<tr>
<td>Topics 40S</td>
<td>3</td>
<td>6%</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2%</td>
<td>0</td>
</tr>
<tr>
<td>Not Science</td>
<td>2</td>
<td>4%</td>
<td>2</td>
</tr>
<tr>
<td>No Response</td>
<td>0</td>
<td>0%</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: Provincial course designations: 10F = Grade 9; 20F = Grade 10; 30S = Grade 11; 40S = Grade 12; *N=51

Assessment of current science curriculum.

A mean rating of 1.86 ($SD = 0.79$) indicated that teachers felt that the current science curriculum was doing a fair to poor job on addressing basic environmental knowledge. This trend continued as can be seen in the similar ratings given to exposing students to environmental issues ($\bar{X} = 1.73, SD = 0.78$) and sustainable development.
(\bar{X} = 1.68; SD = 0.81). Only one teacher gave a rating of Excellent and that was only for addressing basic knowledge (Table 15).

**Table 15**

*Assessment of EE in current science curriculum*

<table>
<thead>
<tr>
<th>Response</th>
<th>How well does the science curriculum teach basic environmental knowledge?</th>
<th>N</th>
<th>%</th>
<th>How well does the science curriculum address environmental issues?</th>
<th>N</th>
<th>%</th>
<th>How well does the science curriculum address sustainable development?</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
<td></td>
<td>2</td>
<td>4%</td>
<td></td>
<td>3</td>
<td>6%</td>
<td></td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td>12</td>
<td>24%</td>
<td></td>
<td>14</td>
<td>27%</td>
<td></td>
<td>16</td>
<td>31%</td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td>27</td>
<td>53%</td>
<td></td>
<td>25</td>
<td>49%</td>
<td></td>
<td>21</td>
<td>41%</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td>7</td>
<td>14%</td>
<td></td>
<td>7</td>
<td>14%</td>
<td></td>
<td>7</td>
<td>14%</td>
</tr>
<tr>
<td>Excellent</td>
<td></td>
<td>1</td>
<td>2%</td>
<td></td>
<td>0</td>
<td>0%</td>
<td></td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>No response</td>
<td></td>
<td>2</td>
<td>4%</td>
<td></td>
<td>2</td>
<td>4%</td>
<td></td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>1.86</td>
<td></td>
<td></td>
<td>1.73</td>
<td></td>
<td></td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td></td>
<td>0.79</td>
<td></td>
<td></td>
<td>0.78</td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
</tr>
</tbody>
</table>

*Notes: Very Poor=0, Poor=1, Fair=2, Good=3, Excellent=4*
Discussion

The Impact of the Science Curriculum on Environmental Knowledge, Attitudes and Behaviours

If the Science 20F curriculum was able to improve the environmental knowledge, attitudes and behaviours of students significantly then there should have been a difference between the grade 9 and grade 10 survey results. Other than the term biodiversity, there was little if any discernable difference in the knowledge component tested. Likewise, the self-reported behaviours of both groups in this regard scored virtually the same – indicating that the 20F curriculum has little impact on changing behaviours.

The most noticeable difference between the grade 9 students and grade 10 students appeared in their assessment of their own abilities to have either a negative or positive impact on the environment. Science 20F appears to have communicated that individuals can make a difference – good and bad. Grade 10 students were also slightly more concerned about the state of the environment.

The focus group interviews provided a few surprising and conflicting perspectives relative to the survey results. This discrepancy between surveys and focus groups has been noted in previous literature on environmental education (Connell, et al., 1999). The grade 9 students, en masse, believed that their actions could affect the environment. The participants in the grade 10 focus group, however, were less confident. One student’s response, “Not as one person,” summed up the group’s attitude. This appears to contradict the survey results. Yet, when asked if they had changed any behaviour as a result of something they had learned in science, half of those in the grade 10 focus group
said they had. Two students reported they were turning off lights and reducing water consumption at home. Other students shared the following: “We recently got low-flow shower heads and like taps and everything...”; “My family started composting. We learned that in science”; and “We got a dual-flush toilet which uses less water.”

When asked, each of these students stated that they had convinced their families to make these changes. The intergenerational effect of environmental education has been well documented and is considered a major benefit of school-based EE programmes (Ballantyne, et al., 2006; Rickinson, 2001). In comparison, not one grade 9 student said they had changed a behaviour or done anything different as a result of something they had learned about the state of the environment in science.

So, why did grade 10 students believe they could have little impact on the environment and yet convinced their families to make significant pro-environmental changes to their household behaviours? In the student surveys, the grade tens were also more alarmed than the grade nines about the state of the environment. Perhaps Science 20F was able to give the students a less naïve perspective on their individual abilities to affect the environment but was able to instil a sense of action, nonetheless.

Having said all this, in two luncheons not one student recycled one cup. How could this be? These students reported that they were engaging in pro-environmental behaviours. They claimed to have convinced their households to change their practices. Having just sat through an interview about the environment one would think the students would be more sensitive to being environmentally responsible?

It appears that there is more work to be done to get students to think automatically and independently about the environment when they act. Perhaps the answer is that the
curriculum needs to address one of the benchmarks that Hungerford and Volk (1990) laid out for successful EE programmes: the participants should develop an internal locus of control. This is where the advocates for EE as education in the environment maintain that it is crucial for students to have first-hand experiences. Schusler and Krasny (2008) found that students who were involved in action projects developed more positive attitudes than students who had not. By having students actively participating in environmental projects, they can develop the lifetime social skills, political skills and action-repertoires of an environmentally-minded person. Chawla referred to this participatory education as “learning to see and learning to take action” (2008, p. 98). A range of activity levels that go from guided and simple to student-initiated and complex can be devised to span grades levels and, ultimately, develop students who are confident and skilled at taking action in the environment (Hart, 2008). Tsevrini (2011) offered a caveat that, when developing these activities, educators do not underestimate or undervalue the critical thinking capacity of children, even in early years.

**General Sources of Environmental Knowledge**

It appears that television plays a significant role, on par with teachers, in providing these students with environmental knowledge. This fits with Rickinson’s review (2001) that found the same relationship – that school and television were the most important sources of environmental information for students. Connell, et al. (1999) found that Australian teens also rated television as their most common source of environmental education, but tended not to trust it as a reliable source. The focus groups were able to shed some light on this result. When asked where they learned about
environmental issues, the students in both grades cited school and teachers much more than any other source. But when asked where they learned how to act environmentally responsibly, both focus groups cited television as many times as school, which agrees with the data from the student surveys. In the one-on-one interviews, teachers’ answers were split between home and school as the primary sources of environmental knowledge. Since teachers in the survey relegated television to a minor role as a source (only 4% of the respondents rated it as the most important) and only one teacher mentioned “media” in the interviews, the importance of television should be noted and pointed out to educators. The students in Connell and colleagues’ study (1999) thought that documentaries (those produced by Attenborough were mentioned specifically) were very credible sources of information. It may be prudent for educators to incorporate high production quality video and film as an integral part of any EE programme. There are numerous free and online resources that would be suitable. The province could help teachers in this regard by publishing EE resource lists and obtaining access to a number of these resources through Instructional Resources (a unit of Manitoba Education).

Considering the ubiquitous, pervasive use of technology by this generation of students, perhaps the most surprising result in this portion of the research was how students relegated the internet and social networks to a very small and minor role as a source of information. The grade 10 students, in particular, rated internet-related technology much less important than their grade 9 counterparts. With no additional evidence, it is not possible to attribute this difference to the EE they received in their grade 10 science and geography courses. More likely is that these grade 10 students may not be using or thinking about the internet and social networks as a way of developing
environmental knowledge or expressing their concerns about human impacts on the environment.

**School Curriculum and EE**

Across all groups involved in this study, science was identified as being the most important subject in teaching EE with social studies coming second. The exception to this trend occurred among the grade 10 students who participated in the focus group interview. For this group, geography was the most important source of knowledge about environmental issues, and they believed that geography should be the course where they learned how to act environmentally responsibly. Kumler (2011), somewhat perplexed by a similar student response, wrote the following:

> …[curriculum] compartmentalization leads students to compartmentalize knowledge: every student involved had taken both social studies and science courses, with the vast majority of students taking both types of courses during the study. Why, then, did students in science classes fail to draw on their knowledge of civic actions from social studies courses? (p.26)

Teachers from all grade levels and backgrounds believed that EE should be taught in science and across all grades. A teacher who had taught both high school social studies and science addressed this issue when stating: “My personal opinion on it is that every science course SHOULD be touching on some kind of environmental issue.”

One disconcerting finding, which possibly bears further investigation, was the response of several middle school science teachers who explicitly stated that EE, Education for Sustainable Development and pro-environmental behaviours should not be
taught in science but should be the purview of social studies. One commented, “Definitely touch base about it in science, but this fits more with the SS curricula.” The questions raised by this are numerous: Do they believe these topics are not science-related? Do they think this is adequately dealt with in the current social studies curriculum? Have they recognized they don’t have time to address this in science? Is there, as some researchers have pointed out, a maturity of student issue at play (Rickinson, 2001)? Or have these teachers reached a roadblock…

…central to environmental education is not the scientific based understanding emphasized in the Pan-Canadian [science] curriculum but the potentially more difficult and politically sensitive task of helping children develop a more sophisticated and critical understanding of the values that inform everyday life. (Hart, 2002, p.1246)

As suggested by Hodson (2010) and Steele (2011), Hart’s values education may be seen by science teachers as politicization, which many science teachers believe does not have a place in the science curriculum and should be left to the humanities. Another disconcerting finding which may be related to this is that teachers who did not indicate that all science curriculum should be involved in EE did not list grade 11 and 12 chemistry or physics as courses that should teach this. One of the teachers interviewed, with 32 years experience in teaching science, lamented that he tried to incorporate some EE into grade 12 chemistry but “it’s a matter of trying to fit it in the time allotted.”

The two open-ended questions at the end of the teacher survey yielded several interesting comments.
Item 16 asked, *Please list any environmental issues that you feel are missing from the Manitoba high school science curricula.* Ten teachers listed topics or issues of varying specificity. These were resource depletion, acid rain, genetically-modified organisms, more on global warming, habitat loss, deep-ocean drilling, and sustainable development. Considering that Manitoba was in the throes of historic flooding in the spring of 2011, and that one of the largest bodies of freshwater which dominates the centre of the province, Lake Winnipeg, has been undergoing dramatic changes in the last few years, the topic of water and water management was mentioned several times. A number of teachers felt that there should be more emphasis on local issues. Several made general comments such as, “Make it relevant, provincially or nationally,” and focus on “Real things!” The sense coming from these comments was summed up by one teacher who wrote:

> I find that there is very little in the curriculum that students can relate to on a personal level. More of an effort needs to be made to show students how environmental issues affect them.

This same sentiment has been made time and time again in the EE literature (Knapp, 2000; Rickinson, 2001; Zelezny, 1999).

**Errors and Limitations of the Study**

This study incorporated grade 9 and grade10 students from one school, so applicability on a wider scale was not intended nor would it be prudent. Because only one school was involved, the role of school culture in shaping students could not be underplayed – as was mentioned by several of the teachers interviewed. One of these
teachers gave the following assessment of the ability of schools to shape environmental behaviours:

..and what they are seeing in the school. If the norm in the school culture is to just throw everything in the trash and there’s no recycling program. Whereas schools that obviously engage in recycling and being environmentally aware it just becomes part of the culture… then kids become guilty when throwing something out that could be recycled.

Focus groups play an important role in delving into the thinking of students’ thoughts and perceptions of science curricula (Osborne and Collins, 2001). With only two groups interviewed, this small subset of one school may skew the conclusions drawn in this study.

The student surveys, themselves, presented a minor problem. It was obvious that many students misread or misinterpreted some of the questions. In particular, a question that asked students to assess their ability to have a positive impact on the environment with choices that incorporated the word help was answered significantly differently than a question that asked them to assess their ability to help the environment with almost identical choices.

Self-reporting of pro-environmental behaviour, itself, has been identified as being not all-together reliable (Chawla and Cushing, 2007) primarily due to social desirability bias (Chang and Krosnick, 2010; Oerke and Bogner, 2011). That is, youth may respond to a survey or interview question with what they believe is a correct or proper answer. This tends to skew results on surveys toward more positive attitudes and behaviours. Social desirability bias is more pronounced in younger children and tends to decrease
with the age of the participants (Oerke and Bogner, 2011). There have been attempts to correct survey results for social desirability but these corrections tend to be complex and difficult to determine (Biglan, et al., 2004). There was no attempt to correct the results in this study for social desirability bias.

Having an online survey was intended to make it easier and more efficient for busy teachers to participate. In addition, this was an environmentally-friendly method of conducting a survey about environmental education. However, the numbers of teachers who chose to respond was much lower than expected, presenting another limitation to this study. Given more time, more school divisions could have been contacted to increase the scope and numbers of teachers who participated.

**Future Directions**

If the world is in the midst of an environmental crisis, as the research of numerous scientists suggests, then it becomes important that we address environmental education boldly and consistently throughout the science curriculum.

As a subject, science is uniquely placed to address environmental education. In a recent analysis of the 2006 Programme for International Student Assessment (PISA), an international survey which assessed the scientific literacy and attitudes of students in 57 countries, Canada placed third highest in interest in science (Bybee and McCrae, 2011). In their study of the attitudes of grade 10 students to science, Raved and Assaraf (2011) found that students continually state environmental issues as being among the most interesting and most relevant to their lives (usually after the human body and diseases).
They also made the following observation in reference to the state science curriculum of Israel,

> It is important to note that the extent of the students’ interest in these topics is wholly disproportionate to the amount of attention they receive in school curricula, a discrepancy worth addressing to regain the sciences’ position in students’ favor (p.1240).

So, from a student’s point of view, it looks as if environmental education should have a successful venue in science education.

Several other factors come into play to make science the ideal subject to incorporate EE. First, whether it be biology, chemistry or physics, all disciplines of science can examine factors that affect the environment, propose remedies, and call students to action. This is not as easy to accomplish in social studies, as was pointed out by one veteran social studies teacher who stated: “I don’t know where [EE] fits when you’re teaching history … or when you’re teaching social studies. It does, but not to the extent as when you’re teaching geography.” Second, based on the results in this study, teachers and students, for the most part, believe that science should be the primary source of EE. Third, chemistry and physics courses, taught in grades 11 and 12, attract students who are generally highly motivated and will likely be pursuing careers in science and technology. What better group to introduce outcomes that actually require them to engage in pro-environmental behaviours or pro-environmental projects? There is also a will among teachers. As one chemistry teacher put it:
I would like to see the higher levels, the Chemistry courses, having an environmental component or use that as a kind of umbrella topic to teach the hard core chemistry topics.

The difficulty is that “science education has remained fundamentally an education for science rather than and education about science” (Osborne and Collins, 2001, p.442). The current Manitoba science curriculum does not appear to be an exception. It is written so that units on the environment are taught in only a few grades and, in the intervening grades, desirable environmental attitudes are listed as STSE (Science, Technology, Society and the Environment) general learning outcomes and not as specific learning outcomes in the curriculum documents. In the Manitoba science curriculum, the outcomes are listed in ‘clusters’ which are numbered for each topic of study. For example, in the Science 20F document, the outcomes for the Dynamics of Ecosystems unit are referred to as Cluster 1. STSE outcomes are usually listed in Cluster 0 and are meant to be interwoven across all the other clusters. But does listing these outcomes as being general or in “Cluster Zero”, itself, cause teachers to misinterpret their importance? Hart (2002) posited that STSE outcomes present a struggle as curriculum teams across Canada attempt to change their traditional models of curriculum. When asked which course students learned the most about being environmentally responsible, one high school science teacher’s answer reflected the status of STSE with the following statement:

I think it’s more hidden, in between courses. Like you might mention it in grade 10 ecosystems. I know I’ve taught a little about it in grade 9 science. It’s almost as if it kind of sneaks its way in between curriculum [sic]- almost as an aside.
This teacher has commented on what Moroye (2009) referred to as the *complementary curriculum*; one that is not stated within curriculum documents but individual teachers will often include in their teaching. If the environment, as one teacher stated on a survey, “is the single most important topic of our time and I think most people honestly don't have a clue how serious this is,” then EE needs to be moved from STSE or sideline status to ‘mainline’ curriculum outcomes.

Another difficulty is that curriculum documents rarely include outcomes that require group or collective action (Kumler, 2011). Chawla and Cushing (2007) maintained that EE needs not only to promote private actions but also needs to emphasize strategic, collective actions. Credence to this stance is given by a study in which students who participated in projects that required them to act collectively significantly increased positive attitudes toward the environment (Schusler, et al., 2009). At the very least, the current science curriculum should be examined and outcomes should be added across all grades that are specifically designed to promote positive environmental attitudes and provide students with hands-on activities that help develop a competence in environmental behaviours (Chawla and Cushing, 2007).

In addition to a direction for educational leaders to move toward, researchers can delve into the integration of EE in the more specialized courses. What will be the response of students and teachers in chemistry and physics if specific learning outcomes were incorporated into these curricula? How successful would an implementation of EE perspectives be in these courses? Would an environmental context-driven curriculum help teach more of the basics of chemistry and physics?
Currently, in Manitoba, the courses *Topics in Science 30S* and *40S* lend themselves to becoming EE courses but, by their very nature, they are meant to be flexible and responsive to students’ interests. Although probable, this does not guarantee that environmental issues would be raised in these courses. Mandating specific EE outcomes in these courses seems to be counter to their core philosophy (Manitoba Education, Citizenship and Youth, 2006).

Is it time for a new, high school course that is strictly dedicated to environmental education? Knapp (2000), in his response to the Thassaloniki Declaration of UNESCO’s 1997 international conference (UNESCO, 1997), levelled sharp criticism at what he saw was a backing down from the original ideals of EE that were proposed 20 years earlier in Tbilisi (UNESCO, 1978) and Belgrade in 1975 (UNESCO, 1975). In order to move away from the “activity-guide mentality” (p. 34) and biased activism, that he believed EE had evolved into, to the development of more substantial autonomous thinking, Knapp argued that environmental education needs to “be infused in formal education as a subject unto itself and not scattered across the curriculum” (p.38). He has a point. In a study of teachers in Wisconsin, Lane and Wilke (1994) discovered that many teachers did not teach EE objectives that were infused across elementary and secondary curricula. These researchers claimed that the reasons for this inattention were primarily due to a lack of teacher confidence and knowledge.

In May 2011, the premiere of the province of Manitoba announced a significant grant programme to upgrade science classrooms that also included an investment to develop websites to help support science education. Where this might benefit teachers, in light of the low rating that students placed on using the internet as a source of knowledge,
the government should possibly conduct their own research into the usefulness of this approach. Considering the unforeseen misinterpretations of the student survey in this study, a component of the province’s investigation should include focus group interviews with current students. This same conclusion was reached by Connell et al. (1999) in their study of environmental attitudes of Australian students.

Here, then, is another opportunity for researchers: to explore the efficacy of video resources in EE. There have been some studies that have addressed this question (Bahk, 2011; Barbas, 2009) but there is not a preponderance of work, particularly in Manitoba or Canada.

Conclusion

Within the limitations of this study, the following conclusions can be made:

- Grade 10 students reported more pro-environmental behaviours than grade 9 students when interviewed. However, when surveyed, both grade 9 and grade 10 students reported the same frequencies of the behaviours listed in the survey. Their directly observed recycling behaviours indicated that neither grade 9 nor grade 10 students were as environmentally-minded as they reported.

- Except for the grade 10 students who were interviewed, both grades of students perceive science as being the curriculum primarily responsible for teaching environmental education. When interviewed, grade 10 students believed that geography was the subject that was most responsible for teaching environmental education.
Teachers from all grade levels and disciplines believed that environmental education should be taught in all grades and in all curricula. Science was the curriculum singled out most often by those teachers who chose one curriculum to be responsible for environmental education.

The Manitoba science curriculum appears to instil positive attitudes toward the environment but this did not translate into pro-environmental behaviours in the context of waste disposal.

For decades, environmental educators have been sounding a clarion call for action. With the environmental woes that currently plague us, the need for pro-active, decisive leadership is paramount. A science curriculum that, from Kindergarten through grade 12, develops a sensitivity to our role in shaping our environment and provides our youth with the skills – both as individuals and as a collective citizenry – to affect positive changes is necessary. This curriculum should engage students on a personal level through the myriad of environmental challenges we face just within our province. Furthermore, a greater coordination with the provincial social studies curriculum to affect similar goals is highly recommended. With the evidence provided in this study, I intend to add my voice to the clarion call and direct it to the educators and educational leadership of the Province of Manitoba.
References


### Appendix A: Manitoba Science and Social Studies Outcomes Pertaining to EE

<table>
<thead>
<tr>
<th>Grade 7 Science</th>
<th>Grade 10 Science</th>
<th>Grade 12 Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cluster 1: Interactions with Ecosystems</strong></td>
<td><strong>Cluster 1: Dynamics of Ecosystems</strong></td>
<td><strong>Unit 5: Conservation of Biodiversity</strong></td>
</tr>
<tr>
<td>7-1-05 Identify and describe positive and negative examples of human interventions that have an impact on ecological succession or the makeup of ecosystems. <em>Examples: positive—protecting habitats, reintroducing species; negative—preventing natural fires, introducing non-indigenous species, draining wetlands for agriculture or housing...</em></td>
<td><strong>S2-1-02</strong> Discuss factors that may disturb biogeochemical cycles. <em>Include: natural events, human activities.</em></td>
<td><strong>B12-5-01</strong> Discuss a variety of reasons for maintaining biodiversity. Include: maintaining a diverse gene pool, economic value, and sustainability of an ecosystem</td>
</tr>
<tr>
<td></td>
<td><strong>S2-1-07</strong> Discuss the potential consequences of introducing new species and of species extinction to an ecosystem.</td>
<td><strong>B12-5-02</strong> Describe strategies used to conserve biodiversity. <em>Examples: habitat preservation, wildlife corridors, species protection programs, public education...</em></td>
</tr>
<tr>
<td></td>
<td><strong>S2-1-10</strong> Investigate how human activities affect an ecosystem and use the decision-making model to propose a course of action to enhance its sustainability. <em>Include: impact on biogeochemical cycling, population dynamics, and biodiversity.</em></td>
<td><strong>B12-5-04</strong> Investigate an issue related to the conservation of biodiversity. <em>Examples: heritage seeds, water quality in Lake Winnipeg, land-use designations, hydroelectric development...</em></td>
</tr>
<tr>
<td>7-1-06 Identify environmental, social, and economic factors that should be considered in the management and preservation of ecosystems. <em>Examples: habitat preservation, recreation, employment, industrial growth, resource development...</em></td>
<td><strong>Science Foundation General Learning Outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>(All Science Curricula)</td>
<td><strong>B1.</strong> Describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies and the environment, both locally and globally.</td>
<td><strong>(All Science Curricula)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>B5.</strong> Identify and demonstrate actions that promote a sustainable environment, society and economy, both locally and globally</td>
<td><strong>C4.</strong> Demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information</td>
</tr>
<tr>
<td>7-1-07 Propose a course of action to protect the habitat of a particular organism within an ecosystem. <em>Examples: protect the nesting habitat of a given bird in a local wetland...</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-1-10 Analyze, using ecological pyramids, the implications of the loss of producers and consumers to the transfer of energy within an ecosystem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 7 Social Studies</td>
<td>Grade 10 Geography</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Cluster 4: Human Impact in Europe or the Americas</strong></td>
<td><strong>Geographic Issues of the 21st Century</strong></td>
<td></td>
</tr>
<tr>
<td><strong>KC-004</strong> Describe ways in which their personal actions may affect quality of life for people elsewhere in the world.</td>
<td><strong>KL-018</strong> Explain the importance of stewardship in the preservation of the Earth’s complex environment.</td>
<td></td>
</tr>
<tr>
<td><strong>VC-004</strong> Be willing to take action to support quality of life for people around the world.</td>
<td><strong>KL-023</strong> Describe the impact of various agricultural practices on the physical environment. <em>Examples: soil erosion, water quality, soil fertility...</em></td>
<td></td>
</tr>
<tr>
<td><strong>KL-028</strong> Describe diverse approaches to land and natural resource use in a society of Europe or the Americas.</td>
<td><strong>KL-030</strong> Describe urban environmental and economic issues. <em>Examples: land use, relationship to hinterland, infrastructure...</em></td>
<td></td>
</tr>
<tr>
<td><strong>KL-029</strong> Give examples of the impact of human activity on the natural environment in a society of Europe or the Americas.</td>
<td><strong>VL-005</strong> Respect the Earth as a complex environment in which humans have important responsibilities.</td>
<td></td>
</tr>
<tr>
<td><strong>KE-053</strong> Describe sustainable development issues in a society of Europe or the Americas.</td>
<td><strong>VL-006</strong> Be willing to consider the environmental consequences of their food choices.</td>
<td></td>
</tr>
<tr>
<td><strong>VL-009</strong> Be willing to take actions to help sustain the natural environment in Canada and the world.</td>
<td><strong>KG-035</strong> Identify implications of more developed countries extracting resources from less-developed countries. <em>Examples: social, political, economic, environmental...</em></td>
<td></td>
</tr>
<tr>
<td><strong>KL-026</strong> Identify human activities that contribute to climate change.</td>
<td><strong>KG-036</strong> Describe issues related to freshwater and saltwater food resources.</td>
<td></td>
</tr>
<tr>
<td><strong>KL-027</strong> Describe social, environmental, and economic consequences of climate change.</td>
<td><strong>KG-037</strong> Give examples of the potential impact of climate change on food production.</td>
<td></td>
</tr>
<tr>
<td><strong>KP-044</strong> Identify ways in which government decisions may affect human impact on the natural environment.</td>
<td><strong>KG-038</strong> Identify issues relating to scarcity and distribution of food.</td>
<td></td>
</tr>
<tr>
<td><strong>KE-052</strong> Identify issues related to food production and distribution in a society of Europe or the Americas.</td>
<td><strong>VG-008</strong> Be willing to consider the social and environmental impacts of their consumer choices.</td>
<td></td>
</tr>
<tr>
<td><strong>KE-054</strong> Give examples of the environmental and social impact of consumerism in the local community and in a society of Europe or the Americas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VE-017</strong> Be willing to consider the consequences of their consumer choices.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Student Environmental Attitude Survey
Environmental Survey

DON’T PUT YOUR NAME anywhere on this survey.

Please answer the questions on this survey as truthfully as you can. This is not for marks and surveys will not be shared with anyone. Please check one box beside the word or phrase that is the best answer for YOU. There are no wrong or right answers.

1) Which one of these apply to you:  □ I am in grade 9  □ I am in grade 10

2) Please check how often you do the following activities:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Every day</th>
<th>Couple times a week</th>
<th>Couple times a month</th>
<th>Once a month</th>
<th>Couple times a year</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycle Paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle Aluminum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle Plastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn lights off to save energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk, ride a bike or choose to take the bus instead of getting a car ride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrange a carpool to save on energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3) **In the following table, please check how well you know each of the terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>I have not heard this term before</th>
<th>I have heard this term before but don’t know what it means</th>
<th>I think I know what it means</th>
<th>I definitely know what it means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse gases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Warming</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat Loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4) **How important is it for people to understand environmental issues?**

- [ ] Not important at all
- [ ] Only a little important
- [ ] It’s important
- [ ] Very Important
- [ ] Absolutely important

5) **How good an understanding of environmental issues do you think the average Manitoban has?**

- [ ] Don’t understand anything
- [ ] Only understand a little
- [ ] Understand enough
- [ ] Understand a lot
- [ ] Fully understand
6) Do you think the Earth’s environment is in trouble?

- No troubles at all
- Only some minor troubles
- Some troubles
- Quite a lot of troubles
- It’s a disaster

7) Do you think that a change in the Earth’s environment is bad for YOU, personally?

- Not bad for me at all
- Only slightly bad for me.
- It has no effect on me.
- It is very bad for me.
- It changes my life entirely.

8) How would you rate YOUR understanding of environmental issues?

- Don’t understand anything
- Only understand a little
- Understand enough
- Understand a lot
- Fully understand

9) How would you rate YOUR ability to have a POSITIVE effect on the environment?

- I can’t do anything at all to help the environment
- I can only help in a small way
- I can have some positive impact
- I can help the environment in many ways
- I can help the environment a LOT!

10) How would you rate YOUR ability to have a NEGATIVE effect on the environment?

- I can’t do anything at all to harm the environment
- I can only hurt the environment a small amount
- I can have some negative impact
- I can hurt the environment in many ways
- I can hurt the environment a LOT!

11) Do you believe that YOU can help improve the environment?

- I can’t do anything at all to help
- I can only help a little
- I can do something to help
- I can do many things to help
- I can be a great help
12) *Where do you learn the MOST about how to help our environment?*

- Environmental clubs
- Facebook
- Field Trips
- Friends
- Google (or other search engines)
- Parents
- Teachers
- TV
- Websites other than Wikipedia
- Wikipedia
- Other:

13) *Which course in school teaches you the most about environmental issues?*

- Art
- English/Language Arts
- Math
- Physical Education
- Science
- Social Studies
- Other:

14) *Please list some things you do, personally, that you think could be harmful to the environment.*

15) *Please list some things you do, personally, that you think could be good for the environment.*
Appendix C: Student Focus Group Interview Script

A. Do you believe that the environment is in danger from human activity?
   a. Probe: What specific human activities are you aware of that are endangering the environment?

B. Are there environmental issues that affect you, personally?
   a. Probe: What are some of those issues?

C. Where have you learned about these environmental issues?

D. Where do you learn the most about how to act environmentally responsible?

E. Do you think school should be where you learn how to be environmentally responsible?
   a. Probe: Where should you learn the most about this?

F. Which course in school do you think you have learned the most about environmental responsibility?
   a. Probe: Is this the course that you believe should be doing this the most?
      i. Probe: Which course should do this the most?

G. Did you learn about how you can make a difference to the environment in science class?
   a. Probe: What did you learn?

H. Do you believe you can make a difference to the environment?
   a. Probe: How?

I. Have you changed the way you act as a result of what you learned in science?
   a. Probe: What exactly are you doing differently?

J. Was there anything you would have liked to have learned about in science class but was not included?
   a. Probe: How might this have helped you?

K. Please suggest ways in which science classes could have a greater impact on students’ behaviours or attitudes towards the environment.
Appendix D: Online Teacher Survey.
Does the Manitoba Science Curriculum Help Teach Teens to be More Environmentally-

Introduction

Researcher:
Gabe Kraljevic
Teacher - Graduate Student - Faculty of Education, University of Manitoba

I am a teacher at [REDACTED] and currently completing a Masters in Education. For my research I need to obtain data on the general knowledge, attitudes and behaviours of students linked to environmental issues and the role of the Manitoba science curriculum in shaping environmental behaviours. This research has received approval from the Seven Oaks School Division and Seven Oaks Teachers' Association.

This survey consists of 15 check box questions and 2 free-response questions. It should take about 10-15 minutes to complete.

Your involvement in this is strictly voluntary and will be completely anonymous. You may pull out and withdraw from the survey at any time by closing the browser and may omit any questions you feel you do not want to answer.

Your participation may help shape the science curriculum in Manitoba.

At the end of the survey you will be given the opportunity to continue with the next phase of the research which will consist of one-on-one interviews.

Informed Consent

This text is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This research has been approved by the Education/Nursing Research Ethics Board at the University of Manitoba and the Seven Oaks School Division. The University of Manitoba Research Ethics Board(s) and a representative(s) of the University of Manitoba Research Quality Management / Assurance office may also require access to your research records for safety and quality assurance purposes. If you have any concerns or complaints about this project you may contact any of the below-named persons or the Human Ethics Secretariat at [REDACTED] or e-mail [REDACTED]

By checking off "I agree to participate in this survey" you will have indicated that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Consent to Continue

☐ Yes, I understand the information above and agree to participate in this survey
☐ No, I do not agree to participate.
Environmental Education Curriculum Survey

Thank you for participating in this Master's research project.

Which of these environment-related activities occur in your school? Please check all that apply. [Question 1 of 17]

- Paper recycling
- Aluminum recycling
- Plastic recycling
- Energy conservation
- EnviroThon team
- Extracurricular clubs
- Student-led Environmental Groups
- Other:

Comments
Feel free to add comments to this question

---

Question 2 of 17

Where do you think students learn the MOST about environmental ISSUES? Please select only one. [Question 2 of 17]

- Environmental clubs
- Facebook
- Field Trips
- Friends
- Internet
- Parents
- School
- TV
- Other:

Comments
Feel free to add comments to this question

---
Question 3 of 17

Where do you think students learn the MOST about how they can HELP the environment?
Please select only one

- Environmental clubs
- Facebook
- Field Trips
- Friends
- Internet
- Parents
- School
- TV
- Other:

Comments
Feel free to add comments to this question

---

Question 4 of 17

Which of these provincial curricula should be MOST important in teaching students about environmental issues or sustainable development?
Please select one

- Language Arts
- Math
- Science
- Social Studies
- All curricula should be involved
- Other:

Comments
Feel free to add comments to this question

---

Question 5 of 17
Which of these science curricula or courses are you currently teaching or have taught in the last 5 years?
Check all that apply

- [ ] I don't teach science
- [ ] K-5 Science
- [ ] 6 Science
- [ ] 7 Science
- [ ] 8 Science
- [ ] Science 9F
- [ ] Science 10F
- [ ] Biology 30S
- [ ] Biology 40S
- [ ] Chemistry 30S
- [ ] Chemistry 40S
- [ ] Physics 30S
- [ ] Physics 40S
- [ ] Topics in Science 30S
- [ ] Topics in Science 40S
- [ ] Other:

Comments
Feel free to add comments to this question

---

**Question 6 of 17**

Which of these science curricula do you feel should include topics in ENVIRONMENTAL AWARENESS?
Check all that apply

- [ ] This should be taught in all the science curricula, K-12. (no need to check below)
- [ ] K-5 Science
- [ ] 6 Science
- [ ] 7 Science
- [ ] 8 Science
- [ ] Science 9F
- [ ] Science 10F
- [ ] Biology 30S
- [ ] Biology 40S
- [ ] Chemistry 30S
CURRICULUM AND ENVIRONMENTALLY-MINDED TEENS

Question 7 of 17

Which of these science courses do you feel should include topics in SUSTAINABLE DEVELOPMENT?
Check all that apply
- This should be taught in all the science curricula, K-12. (no need to check below)
- K-5 Science
- 6 Science
- 7 Science
- 8 Science
- Science 9F
- Science 10F
- Biology 30S
- Biology 40S
- Chemistry 30S
- Chemistry 40S
- Physics 30S
- Physics 40S
- Topics in Science 30S
- Topics in Science 40S
- This should not be taught in the science curricula
- Other:

Comments
Feel free to add comments to this question
Question 8 of 17

Which of these science courses do you feel should include topics that teach students how to ACT ENVIRONMENTALLY RESPONSIBLE?
Check all that apply

☐ This should be taught in all the science curricula, K-12. (no need to check below)
☐ K-5 Science
☐ 6 Science
☐ 7 Science
☐ 8 Science
☐ Science 9F
☐ Science 10F
☐ Biology 30S
☐ Biology 40S
☐ Chemistry 30S
☐ Chemistry 40S
☐ Physics 30S
☐ Physics 40S
☐ Topics in Science 30S
☐ Topics in Science 40S
☐ This should not be taught in science courses
☐ Other:

Comments
Feel free to add comments to this question

Questions 9-15 of 17

Please check off the box that best applies to the comment or question on the left.

<table>
<thead>
<tr>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
</table>

Please rate the average Manitoba citizen's understanding of environmental issues.
<table>
<thead>
<tr>
<th>Question</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please rate the average attitude of your students towards the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please rate your students' overall treatment of the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How well do the provincial science curricula do in teaching students basic knowledge about the environment?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How well do the provincial science curricula address environmental issues?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How well do the provincial science curricula address sustainable development?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate the overall understanding of environmental issues exhibited by an average grade 9 student?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments
Feel free to add comments to this question

Questions 16 and 17 of 17

Please list any environmental issues that you feel are missing from the Manitoba high school science curricula.
Please feel free to make any comments about any of these questions, science curriculum or the teaching of environmental issues.

Thank you for participating in this survey!

Below you may indicate if you would like to obtain a summary of the findings of my research.

You also have the opportunity to participate in the second phase of the study in which I will be interviewing individual teachers about some of the issues raised in this survey. These interviews will be confidential and should take about 20-30 minutes and would be conducted during a mutually agreed upon time.

Your answers in the survey are anonymous and will not be traced to your contact information.

You can provide contact information by filling out the box below or contacting me directly at:

gabe.kraljevic@[redacted]

FOLLOW UP
Your answers in the above survey will not be matched to you if you check any of the boxes below.

☐ Yes, I would like to receive a summary of your findings.
☐ Yes, I would like to volunteer for an interview.

Contact Information
Only fill this in if you wish to receive a summary of my findings or wish to volunteer for an interview.

Thank you for your time.
Appendix E: Teacher Interview Script

A. What science courses do you teach right now?
B. What science courses have you taught in the past?
C. Where do you believe students learn the most about how to act environmentally responsible?
D. Do you believe that schools can teach students how to make a difference to the environment?
   a. Probe: How?
E. Which course in school do you think students have learned the most about being environmentally responsible?
   a. Probe: Is this the course that you believe should be doing this the most?
   b. Probe: Which course should be the most important in this matter?
F. What, if anything, do students learn in science classes right now about how to make a difference to our environment?
G. Do you believe that science can teach students how to behave differently toward the environment?
H. Do you believe that science courses should teach students how to behave environmentally responsible?
   a. YES? Probe: What exactly could science teach students in this regard?
   b. NO? Probe: Where do you think this should be taught?
I. What is missing in the Manitoba science curriculum with respect to environmental awareness, sustainable development, etc.?
   a. Probe: How might this help students?
J. Please suggest ways in which science classes could have a greater impact on students’ behaviour or attitudes towards the environment.
Appendix F:

Sample Parental Consent Form for Student Participants
Request for Consent to Participate in an Education Research Project

Researcher: Gabe Kraljevic
Teacher - [Name Redacted]
Graduate Student - Faculty of Education, University of Manitoba

Research Project Title: Does the Manitoba Science Curriculum Help Teach Teens to be More Environmentally-Minded?

Dear Parent/Guardian,

I am a teacher at [Name Redacted] and currently completing a Masters in Education. For my research I need to obtain data on the general knowledge, attitudes and behaviours of students linked to environmental issues. Participation in this study may help shape the science curriculum in the Province of Manitoba. This research has received approval from the University of Manitoba Research Ethics Board, the Seven Oaks School Division and [Name Redacted], principal of [Name Redacted]. I would like to ask for your permission to allow your son or daughter to participate in this research.

Your child’s involvement in this is strictly voluntary and participation or lack of participation in the study will in no way impact his or her grades. At any time before or during the study your son or daughter may pull out without any risk.

The Study

**PHASE 1: Survey**
Attached you will find a short survey that should take about 10 minutes to complete. Students are asked to complete the survey as truthfully and honestly as possible. Their answers are strictly voluntary and students do not have to answer all the questions if they so wish. Once completed, they should return the survey to the school office or directly to me along with the parental consent form filled out. **PLEASE DO NOT ATTACH THE CONSENT FORM TO THE SURVEY.**

**PHASE 2: Focus Group**
Those students who have indicated that they would like to volunteer for the second part of the study will be invited to participate in a focus group interview. In a group setting they will be asked several questions about their science courses and environmental topics. **These interviews will be conducted during a lunch hour and the students will receive a pizza lunch for their time.**

Participant Confidentiality

At no time will students be asked to identify themselves on the survey or in the group interview.

Consent forms and surveys will not be attached to each other. Surveys will not be numbered or coded to link students to their answers. I will be the only person to read the surveys, which will be destroyed shortly after the thesis defense (October 2011).
Consent to Participate in an Education Research Project:

Does the Manitoba Science Curriculum Help Teach Teens to be
More Environmentally-Minded?

If your child participates in a focus group the session will be audio-recorded on an MP3 recording device so that I can transcribe student answers later. I will be the only person who will have access to, listen to and transcribe the audio. Shortly after my thesis is defended the audio files will be erased (October 2011).

Feedback
On the consent form you may check off that you would like to receive feedback on the results of the study. If you supply your email address I will send you an overview of what was learned from the study. In addition, I will provide a copy of my research paper to anyone who asks for one on the consent form.

A copy of my final research paper will be provided to any students or parents who would like to read the results of the study. As well, I would be open to requests to make a presentation to classes, schools or parent groups.

Please keep this letter for your own records and return the last page if you choose to give your consent.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your child's participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This research has been approved by the Education/Nursing Research Ethics Board at the University of Manitoba and the Seven Oaks School Division. The University of Manitoba Research Ethics Board(s) and a representative(s) of the University of Manitoba Research Quality Management / Assurance office may also require access to the research records for safety and quality assurance purposes. If you have any concerns or complaints about this project you may contact any of the below-named persons or the Human Ethics Secretariat at [redacted] or e-mail [redacted]

- Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to allow your child to participate as a subject.
- In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities.
- You or your child are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence.
- Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Principal Researcher: Gabe Kraljevic, [redacted]

gabe.kraljevic@[redacted]

U of M Faculty Advisor: Barbara McMillan, [redacted]
Consent to Participate in an Education Research Project:
Does the Manitoba Science Curriculum Help Teach Teens to be
More Environmentally-Minded?

PLEASE RETURN THIS, UNATTACHED, WITH THE COMPLETED SURVEY.

Name of Student __________________________________________

Please check the appropriate boxes:

☐ I give consent for my child to participate in the survey.
Parent/Guardian Signature __________________________ Date ____________

☐ I give consent for my child to participate in the focus group interview.
Parent/Guardian Signature __________________________ Date ____________

☐ Please send us an email of the research results. Email____________________________
☐ Please provide us with a copy of the final research paper.

Student Signature __________________________ Date ____________

Researcher Signature __________________________ Date ____________
Appendix G: Sample Teacher Consent Form for Interviews
Consent to Participate in an Education Research Project

Researcher: Gabe Kraljevic
Teacher - [Redacted]
Graduate Student - Faculty of Education, University of Manitoba

Research Project Title: Does the Manitoba Science Curriculum Help Teach Teens to be More Environmentally-Minded?

Dear Colleague,

I am a teacher at [Redacted] and currently completing a Masters in Education. For my research I need to obtain data on the general knowledge, attitudes and behaviours of students linked to environmental issues and the role of the Manitoba science curriculum in shaping environmental behaviours. This research has received approval from the University of Manitoba Education/Nursing Research Ethics Board and your school division.

Your involvement in this is strictly voluntary and will be kept anonymous. You may pull out and withdraw your consent verbally or in writing before, during or after the interview without any risk or prejudice. Any recording or transcript of the interview will be erased immediately upon withdrawing your consent. You may refuse to answer any questions you prefer to omit.

Your participation may help shape science curriculum in Manitoba.

The Study
The following describes what the teachers participating in this part of the study will be asked to do.

One-on-One Interview
Teachers from grades 6 through 12 who have indicated a willingness to be interviewed will be contacted. These interviews will be conducted during a mutually agreeable time and take approximately 20-30 minutes to conduct.

Participant Confidentiality
Your interview will be audio-recorded on an MP3 recording device so that I can transcribe your answers later. I will be the only person to listen to these recordings and you will not be asked to identify yourself. I will not record your name in either my notes or in the name of the audio file. I will be the only person who will have access to, listen to and transcribe the audio. Shortly after my thesis is completed the audio files will be erased (October 2011).

Feedback
A summary of my findings or a copy of my final research paper will be given to all participating teachers who would like to read the results of the study. As well, I would be open to requests to make presentations to classes, schools or parent groups. I will provide a copy of the paper to anyone who asks for one.

Please keep this page for your own records and return the second page if you choose to give your consent.
This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This research has been approved by the Education/Nursing Research Ethics Board at the University of Manitoba and the Seven Oaks School Division. If you have any concerns or complaints about this project you may contact any of the below-named persons or the Human Ethics Secretariat at

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Principal Researcher: Gabe Kraljevic, gabe.kraljevic

U of M Faculty Advisor: Barbara McMillan

Participant's Name: ________________________________

Participant's Signature ____________________________ Date ____________

Researcher Signature ____________________________ Date ____________
Appendix H: Ethics Approval Certificate
CURRICULUM AND ENVIRONMENTALLY-MINDED TEENS

APPROVAL CERTIFICATE

April 12, 2011

TO: Gabriel Kraljevic
   Principal Investigator

FROM: Stan Straw, Chair
   Education/Nursing Research Ethics Board (ENREB)

Re: Protocol #E2011:012
   “Does the Manitoba Science Curriculum Help Teach Teens to be
   More Environmentally-Minded?”

Please be advised that your above-referenced protocol has received human ethics approval by the Education/Nursing Research Ethics Board, which is organized and operates according to the Tri-Council Policy Statement. This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- If you have funds pending human ethics approval, the auditor requires that you submit a copy of this Approval Certificate to the Office of Research Services, fax 261-0325 - please include the name of the funding agency and your UM Project number. This must be faxed before your account can be accessed.

- If you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.


Bringing Research to Life