Community Educating Action: Enabling the Community to come out on Climate Change

Includes:
Final Research Report
Bibliography

By Andrew Sauve

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Professor Tom Hutchinson, Trent University
Trent-Centre for Community-Based Education

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Community Educating Action: Enabling the Community to Come Out on Climate Change

Abstract:
This project, commissioned by Peterborough Green-Up, looks at current attitudes toward climate change in the community, drawing information from studies by Metroline and others, which found that Peterborough residents tend to have a basic, but limited understanding of climate change. Despite general benevolence toward the environment, residents are apathetic about community action. There is a need for education on climate change, its effects on the community, and the practical action that can be taken. The researcher identifies and evaluates a number of climate change education materials available for use elementary schools and the community at large, which include textbooks, education kits, software, and internet resources. The researcher concludes that many satisfactory resources are available. Though none of the resources are deemed to be exceptional alone, all could be highly effective as part of a unit on climate change making use of two or more resources.

Keywords: Peterborough Green-Up, Metroline, community, environment, climate, atmosphere, climate change, ozone depletion, greenhouse effect, global warming, gas emissions, pollution, curriculum, education, elementary

Community Research Project

Community Educating Action: Enabling the Community to come out on Climate Change.

Prepared for Peterborough Green-Up

By Andrew Sauve

Trent University Environmental Science Major

April 2003

Project Scope:

The general purpose of this research project has been to identify and evaluate the current resources available for climate change education among elementary grade levels. These resources were evaluated based on their ability to effectively communicate the topic of climate change, connections to the Ontario education curriculum and their relevance to community action. Peterborough Green-Up believes that the community of Peterborough is lacking in a full understanding of the issue of climate change and its consequences. It also believes that people in the community are not making the connection between their personal actions and the causes of climate change.

This educating action has been conducted with 4 primary research questions that were addressed in the course of the project's research. These research questions are:

- What current climate change material exists? How effective are these materials in promoting awareness and action for climate change?
- How can these materials be adapted for use by elementary students and teachers?
- How can these or other materials be implemented in a way that reaches out of the classroom and into the community?
- What are the current attitudes towards climate change in the community?

To answer the first 3 of these questions a complete review of the material collected was conducted to assess each resources value for education and community action. The teaching material used is discussed in great detail to provide readers with a sense of the activities and units offered by these resources, without having to read the actual resource.

Other components of this research include a brief summary of the prevalent attitudes and perceptions relating to climate change among the Peterborough community and a summary of the project's findings. Educators wishing to view copies of the resources described throughout the course of this research can access them through Peterborough Green-Up or via the World Wide Web.

Community Perceptions of Climate Change:

In February of 2000 the Metroline research group Inc. conducted 2 focus groups in the Peterborough community to gauge the communities attitudes and comprehension concerning the issue of climate change. Community members from a variety of demographic compositions formed both focus groups. When asked 'what is climate change?' The focus groups' responses included references to warmer summers and winters, drought conditions and more violent weather systems. There also seems to be a prevailing confusion of climate change, global warming and ozone depletion. Global warming and ozone depletion are both considered symptoms of climate change yet, neither describes the full extent of climate change. When asked what key terms come to mind when climate change is mentioned the most common responses were global warming, the greenhouse effect and El Nino/La Nina. By and large the participants in this survey showed a general desire to the 'do the right thing' when it comes to the environment, however a fundamental lack of understanding regarding climate change has prevented large scale community action on the issue. One major finding of Metorline's research was that most community participants believed they did not have a significant impact on changing the climate, compared to industry.

It was also stated that for action to be taken by Canadian citizens, the government should legislate action to help mitigate climate change. In one of the focus groups a community member is quoted as saying "When we were younger we didn't know the effects of what we were doing (to the environment) or what the consequences were, we're learning." All of these findings reflect the concerns of Peterborough Green-Up; the community does not

seem to be making the connection between climate change and their personal actions. Based on the findings of Metroline's research it seems that the Peterborough community has a basic idea of the consequences of climate change, but since no truly noticeable effects of this phenomenon have occurred, community action is slow to be taken.

Since the community seems to display a lack of understanding of the true nature of climate change, Peterborough Green-Up will focus on education of the issue in the classrooms of the community in hopes to increase awareness and that resulting action will occur to lessen the community's impact on climate change. The confusion among community member does not exclude teachers. Fortner (2001) states that research has determined climate change to be a topic of much confusion among schoolteachers in Ohio, USA. This is largely due to the complicated nature of climate change subject matter. Peterborough Green-Up feels that teachers in the community are not equipped with the tools necessary for effectively communicating the issue of climate change to students and in turn the community. Through the course of this research considerations of how the topic of climate change will be communicated by teachers with little or no background in the subject were made. Adams (2001) believes that confusion concerning the science of climate change has likely stemmed from conflicting results of global climate models. It should also be noted that even some professionals such as policy makers and political analysts also have a relatively low understanding of the specific scientific concepts surrounding climate change (Adams, 2001). McBean & Hengeved (2001) also supports the community specific findings of Metroline research on a national scale by stating that scientists and educators alike will experience similar challenges in

informing the lay person about the seriousness of climate change. There seems to a lack of understanding and general apathy among the Canadian public in regards to climate change (McBean & Hengeved, 2001). In the United Kingdom a study was conducted by having students complete a survey form concerning the greenhouse effect. This survey was the same as one conducted with a similar group of students 9 years previous. The findings revealed that the current generation has less knowledge concerning specific scientific concerns, yet their general awareness about the topic has increased, resulting in fewer misconceptions regarding climate change (Boyes & Stanisstreet, 2001). Due to the overall lack of knowledge and general apathy towards climate change Peterborough Green-Up has expressed the need for an education action to be taken in regards to climate change and the Peterborough Community.

References:

- Adams, S., 2001. View of the Uncertainties of Climate Change: A Comparison of High School Students and Specialists. Canadian Journal of Environmental Education vol 6: (18-31)
- Boyes, E., and M, Stanisstreet, 2001. School Students' Ideas about the "Greenhouse Effect" a Decade On. Canadian Journal of Environmental Education vol 6: (18-31)
- Fortner, R.W., 2001. Climate Change in School: Where does it fit and how ready are we? Canadian Journal of Environmental Education vol 6: (18-31)
- McBean, G. and H. Hengeved, 2001. Communicating the Science of Climate Change. Canadian Journal of Environmental Education vol 6: (18-31)

1. Background Information:

Resource Title:

Our Changing Climate - Learning how to take Charge of Climate Change at School, Home and in the Community.

Cost:

Unknown

Publisher:

Toronto Environmental Alliance
122 St. Patrick Street, Suite 209
Toronto Ontario
M5T 2X8
Tel: (416) 596-0660
Fax: (416) 596-0345

Learnxs Foundation
155 College Street
Toronto Ontario
M5T 1P6
Tel: (416) 393-1018

Curriculum:

Applicable Grade Levels:

- This kit states that it is designed for ***junior grade levels (1-6).***
- Younger grade levels (1-3) will most likely not be able to make use of many of the activities in this resource due to their complexity or necessity for background knowledge.
- Many lessons and activities found in this resource can be adapted to demonstrate basic concepts to younger grades (i.e. what a greenhouse is vs. how a greenhouse works).

Curriculum Connections (Science and Technology):

- This resource was produced in 1997; therefore it does not coincide with the Ontario curriculum that was released in 1999.
- Learning Outcomes and ties to the old curriculum may be applied to satisfy outcomes of the new curriculum with some effort

- Outside the specific outcomes tied to the old curriculum this resource has 10 other 'essential outcomes' which are as follows:
  1. Communicate effectively.
  2. Solve problems and make responsible decisions using critical and creative thinking.
  3. Use technology effectively.
  4. Demonstrate an understanding of the world as a set of related system.
  5. Apply the skill needed to work and get along with other people
  6. Participate as responsible citizens in the life of the local, national and global communities.
  7. Explore educational and career opportunities.
  8. Apply aesthetic judgement in everyday life.
  9. Make wise choices for healthy living.
  10. Use the skills of learning to learn more effectively.

Curriculum Connections (Other):

This resource has specific learning objectives for the following categories of the old curriculum:

- Arts
- Language
- Social Studies

Comments on curriculum appropriateness:

This is a good resource with well-defined outcomes for learning. However, the underlying problem for use of this resource by all teachers is that it would be very time consuming, although not impossible, to adapt the lessons in this package to the current curriculum.

Teaching Materials:

This resource strikes a balance between teaching necessary scientific concepts to understand climate change and applying that knowledge to make good ethical and social

decisions. Some lessons focus on media issue, communication or social studies curriculum rather than science and technology curriculum. However, the lessons that focus on science and technology outcomes are well organized and comprehensive, making them a valuable resource to junior teachers focusing on the science of climate change. Scientific experiment is combined with conceptual knowledge to add to the scientific value of this resource.

'Our Changing Climate' is divided into six main chapters independent of the glossary and appendices. Each chapter focuses on a different aspect of climate change. The chapter topics are as follows:

- Chapter 1: Climate Change
- Chapter 2: School Transportation Audit - The case of the Carl Von Dioxide Gang
- Chapter 3: Energy Use and the Home
- Chapter 4: Exploring Energy Sources
- Chapter 5: Consensus Building
- Chapter 6: Climate Change Around the World

There are a varying number of lessons in each chapter. Below is a brief description of the lessons found in each chapter:

- **Chapter 1: Climate Change**
  - **Lesson 1:** Space ship earth - The story of 'spaceship earth' is used to introduce and discuss world and local problems such as deforestation, climate change, pollution, hunger, homelessness and other.
  - **Lesson 2:** Life Support System - In the style of Project Wild's 'habitat lap sit' students participate in this group exercise to learn the balance and functions of a system.
  - **Lesson 3:** The Greenhouse Effect - The concept of what a greenhouse is and how the earth works as a greenhouse is discussed. This lesson is illustrated through an experiment demonstrating the effects of a greenhouse on the growth of seeds.
  - **Lesson 4:** More Greenhouse Experiments - This lesson build on the greenhouse concept and uses 2 experiments to demonstrate the how different surfaces absorb

light and the concept of diffusion. The first experiment has students place a black piece of paper and a piece of tin foil under 2 different jars to observe the effects. The second uses the entire class to visually demonstrate how diffusion works (*gases travel from areas of high concentration to areas of low concentration*).

- **Lesson 5:** Greenhouse Gases - Students identify four greenhouse gases and learn of their sources. In small groups, a worksheet matching these greenhouse gases to their sources is completed.
- **Lesson 6:** Impacts of Climate Change: A Look at Canada - Maps and artwork are used to discuss some of the potential scenarios and impacts of climate change for Canada.

- **Chapter 2**: School Transportation Audit - The case of the Carl Von Dioxide Gang
  - **Lesson 7:** Top Secret! - Using the theme mentioned above, students are expected to brainstorm possible source and sinks of C02 in their school. As part of a homework assignment, students interview a car owner. In class, the results from this interview (i.e. distance traveled/day, car mileage, # of car-poolers) are compared to kilograms of C02 released/year based on various car mileage.
  - **Lesson 8:** Community Map - Using an enlarged map of the community students plot their routes to school and coordinate them with a legend to display the mode of transportation. The total distance traveled by each mode of transportation is the summarized by the students in a table.
  - **Lesson 9:** Field Work (Outdoor Day) - Students explore the grounds of their school, tallying trees, sketching good and bad environmental practices and monitoring road traffic.
  - **Lesson 10:** The Answer - Using the data and information compiled in previous lessons students answer "The Big Question" is their school and community atmospherically friendly.
  - **Lesson 11:** Graphing (The Report) - Students use the same data and information and organize it in charts and graphs to graphically display their results.

- **Chapter 3**: Energy Use in the Home

- **Lesson 12:** Energy Use: Yesterday and Today - This activity is estimated to take 45 minutes, but could be significantly longer. It involves students reading, or being read to, a story describing the lifestyles of kids their age 100 years ago. Students compare past lifestyles with modern lifestyles, this comparison is used to show students that each person has a personal impact on C02 usage/ per year. Students brainstorm the ways they consume energy in their lifestyles.
- **Lesson 13:** The Home Energy Saving Action Plan - After brainstorming the possible ways that energy is consumed in the home, students organize an action plan for their family to follow. The action plan focuses on wise use of energy and eliminating wasteful habits such as leaving lights on in unoccupied rooms. The Appendix has 2 extension activities for the students. The first is a drawing with examples of energy waste in the home; students are asked to identify the wasteful practices. The second is done as homework where students monitor the lights in their home and created a report card based on efficiency and waste (i.e. lights off when room unoccupied, use of natural light, etc).

- **Chapter 4: Exploring Energy Sources**
  - **Lesson 14:** Research - Again, this activity claims it should run approximately 45 minutes, however will likely take a greater amount of time to complete. Students work in small groups to research the advantages and disadvantages of a designated energy source. Renewable and non-renewable energy source are explored using the Internet, library, CD-ROM and other available material. This lesson makes no specific references to appropriate websites or resource titles, however a list of resources is given in the back of the kit. As an extension to this lesson, students can prepare a display or presentation for the class. Students can the compare the advantage and disadvantages of each energy source.
  - **Lesson 15:** TV Persuasion - Students review television commercials and discuss the various methods advertisers use to sell their product. After reviewing 3 television commercials, students prepare advertisements for their assigned energy source.

- **Lesson 16:** On With the Show - Students present their commercial the class for peer evaluation. An evaluation form is provided for the students. By the end of this activity students will have gained an ability to recognize bias and critically evaluate their peers. Students are also expected to have an understanding of the advantages and disadvantages of each energy source.

- **Chapter 5: Consensus Building**
  - **Lesson 17:** Roundtable Discussion - This activity is designed to take more than one class period. Students are split into interest groups and asked to openly discuss how environmental issues are connected with economic, political and social issues. The teacher serves as the facilitator and should reinforce the importance of appropriate behaviour and the fact that the interest groups are trying to build consensus, not persuade other parties. The discussion involves brainstorming solutions to climate change, outlining the steps necessary to achieve each solution and practical ways of implementing them. The facilitator tries to find common ground and to obtain compromise so that each interest group is satisfied with the proposed solutions. The interest groups and their standpoints are included in a handout for this lesson.

- **Chapter 6: Climate Change Around the World**
  - **Lesson 18:** World Tour - The central idea behind this chapter is to encourage the students to "Think Globally, Act Locally." This lesson has students identify other nations on a map and examine the amount of pollution and greenhouse gas each of these nations produces. Students examine the difference between these countries total emissions and per capita emissions. Hand outs and information sheets are provided using data from 1990, limiting the usefulness of this information. However, with some effort this data can be updated to represent current trends in greenhouse gas emissions.
  - **Lesson 19:** Transitville - Students use the knowledge they have gained in previous lessons to plan their own 'transit based' community. In small groups students are asked to construct a community with a high-density population. The

fictional communities are planned using a base map with a subway system drawn on it and several cut-out pieces to represent homes, apartment buildings, schools, businesses and parks. Students must attempt to arrange (plan) the community for maximum energy efficiency.

Summary of Applicability to Science and Tech:

The "Our Changing Climate" curriculum unit addresses some of the most important aspect of climate change in its units. However, this resource does not maximize its potential for use in the classroom. The activities and lessons in this unit are engaging for the students and teachers but rely heavily on overheads and paper handouts for the students. There is no supporting audio/visual material, leaving teachers to find these on their own. The lessons in this unit are primarily based on activities done in small groups or as an entire class; homework assignments and other individual work are also included to a lesser degree. This is a very user-friendly unit, however its does tend to be overly simplistic at times. It makes good use of scientific method for some of its activities, however on its own would not be sufficient to meet the needs of today's science and technology curriculum. Supplements to the lessons such as a resource section, glossary and climate change overview are provided with this resource. The resource section can provide teachers or those seeking more information on climate change with links and contacts that should be sufficient for most junior level needs.

Summary of Relevance to Community Action:

What this resource lacks in current science and technology curriculum connections it could make up for in community and social awareness. Since this unit was originally intended for use in the Greater Toronto Area it makes direct connections to the practices of a community and the effects on climate change. It then uses this connection to introduce the students to the concept of a global community. This resource makes an excellent effort to encourage the students to "Think Globally and Act Locally" and carry this attitude on into their community.

2. Background Information:

Resource Title:

Changing Our Future: Great Lakes Climate Change

Cost:

$125 (Acquired for $100)

Publisher:

The Lake Huron Centre For Coastal Conservation
P.O. Box 178
Blyth, Ontario
N0M 1H0
(519) 523-4478
coastalcentre@lakehuron.on.ca
www.lakehuron.on.ca

Author(s):

Geoffrey Peach
Patrick Donnelly (Supporting Author)

Curriculum:

Applicable Grade Levels:

This kit focuses on Grade 7 curriculum. However, the authors claim that the material in this kit can be adapted to younger grade levels. This is certainly possible with the Science and Technology curriculum. For example the 3rd section of this kit, "Impact to Ecosystems," could have strong connections to the grade 4 habitats and community curriculum objectives. The 2nd section, "Human Influences on Climate Change," would also have strong ties to subjects pertaining to Energy and Control such as Conservation of Energy (Grade 5).

It should be noted that there is a limit to the applicability of this resource for younger grades. Students in early grades (1-4) may not have the background knowledge necessary for some of the lessons in this unit. This is largely due to the emphasis put on ecosystems and communities, topics that aren't stressed until at least grade 4.

Curriculum Connections (Science and Technology):

Two particular categories of the **Grade 7** Science and Technology curriculum can be applied directly to studies relating to climate change. These categories *are Interactions with Ecosystems* (**Life Sciences**) and *Heat* (**Energy and Control**). The introduction to the unit lists the objectives that can be accomplished through the use of the kit, including overall expectations and specific expectations. Three sample rubrics are included in the kit. These rubrics are examples from lessons in the kit. Teachers can use these rubrics as a guide for evaluating students' progress and abilities.

Curriculum Connections (Other):

Other curriculum expectations that are met are also listed in the introduction to the kit. For the **Geography** curriculum the kit covers one overall, and several specific expectations for the grade 7 ***Natural Resources*** portion of the curriculum. For the **Language** curriculum, this kit includes activities that promote ***Reading***, ***Writing*** and ***Oral and Visual Communication.***

Teaching Materials:

Each main section to this kit includes Teacher's notes, Student Resource (information) sheets and Student Activities. There are 5 main sections to this kit. They are:

- Section 1: Natural Climate History
- Section 2: Human Influence on Climate Change
- Section 3: Impact to Ecosystems
- Section 4: Impacts to Local Communities
- Section 5: Changing Attitudes

Included with these main sections are the introduction, accompanying overheads, plus a glossary and bibliography. The following is a brief description of each of the 5 main sections:

Section 1: Natural Climate History - This section's Teacher's notes provide background information necessary to understand the patterns of climate around the world and particularly the Great Lakes region. Topics such as heat exchange, atmosphere, circulation, convection and the hydrologic cycle are discussed. The Student Resource Sheets in this section discuss climate in regards to the Great Lakes region. This section is designed to reinforce the fundamentals of climate and to discuss how climate has changed throughout time.

An activity called Climate Change Alphabet is included at the end of the section. In this activity students are assigned letters of the alphabet. Words relating to climate change are brainstormed for each letter. The students are then asked to write a short paragraph to describe the word.

Section 2: Human Influence on Climate Change - In this section the issue of humans influencing climate is discussed. The influence humans are known to have in regards to global warming, the greenhouse effect and the natural carbon cycle are explained and accompanying overheads are provided to assist the teacher in explaining each to the class. An experiment using mayonnaise jars and thermometers is included to demonstrate the greenhouse effect

This section concludes with an oral history project for the students. Students are expected to use resources such as the Internet and library to gather information on past climate history such as precipitation and temperature. This data is compared to personal knowledge that is to be gathered by interviewing older members of the community. This activity opens many opportunities for creative writing, oral and visual communication by suggesting projects students can engage in to summarize and present their results.

Section 3: Impacts to Ecosystems - In this section the projected impacts to ecosystems along the Great Lakes are considered. The relevance of this section to students in the Peterborough region is limited due to the focus on Great Lake ecosystems. However, it should be noted that most of the impacts to Great Lake ecosystems will parallel impacts

to ecosystems in the Kawartha Lakes region. Topics such as effects on aquatic life, forest migration, insect outbreaks, invasive species, air quality and water quality are discussed. Certain aspects of this section may not be useful to teachers in the Peterborough community (i.e. effects to coastal dunes), however others are easily adapted to incorporate local examples. Activities include:

- Climate Change and Ecosystems - Students explore the interdependency of organisms in various ecosystems, and how climate change is likely to affect this interdependency.
- Maples on the Move - Students are introduced to the concepts of forest succession and migration. However, requires a wooded area to conduct 'tree inventory.'
- How Trees Migrate - Students learn of the ways forests migrate due to climatic change.
- Climate Art - Climate change buzzwords are used to play a version of "Pictionary" with the class.

Section 4: Impacts to Local Communities - This chapter takes a broad approach to discussing the impacts of climate change to local communities. Once again it is centered around Great Lakes communities, however could have a broad application for the whole province, including Peterborough. Environmental, social and economic factors are discussed with the students including how climate change is likely to affect agriculture, shipping and pleasure boating, municipal infrastructures and tourism/recreation in the Great Lakes basin, particularly in Lake Huron. However, this chapter does little to support the discussion it offers in the students and teachers notes in regards to the above mentioned topics. The only activity available for students in this chapter is titled Climate Change and Disease. It takes an in-depth look at how climate change is likely to facilitate the spread diseases, viruses and parasites. Examples using malaria and west nile virus are used. An excellent list of suggested resources is provided at the end of the chapter.

Section 5: Changing Attitudes - As the final installment of this resource, this chapter attempts to have students make the connection between their personal action and global climate change. An extensive lists of organizations that tackle climate change issues is provided in the teacher's notes. 3 activities are provided in this section, they are:

- Adding It All Up - An activity to have students consider how much carbon they and their family produce.
- What Can You Do? - Students brainstorm ways they can reduce their personal greenhouse emissions.
- Pledge on Climate Change - Students are provided with pledge forms they can bring home to their family. The student and family fill out the pledge form and hopefully follows those pledges to reduce their greenhouse gas emissions.

This section finishes with 3 different field trip activities for classes to take part in. Each of these trips is to a location on Lake Huron's coastline. The first is to The Douglas Point area near Bruce Nuclear Power Development and Information Centre. Teacher's in Peterborough can incorporate a trip to Darlington Provincial Park on the coast of Lake Ontario to supplement this activity and a discussion on nuclear power that follows. The topics discussed in the other 2 field trips, such as changing water levels, poor water quality and alternative energy can easily be adapted for schools in the Peterborough region.

Supporting Media:

This resource comes with a CD-ROM containing several slides appropriate to the subjects discussed throughout the resource. Overheads on the hydrologic cycle, greenhouse effect, carbon cycle and human impacts regarding climate change are also provided. Please note that purchasing this resource from the Coastal Centre for Conservation will cost approximately $125. This cost is unfortunately NOT reflected in the quality of audio/visual material provided.

Summary of Applicability to Science and Tech:

'Changing Our Future' can be considered one of the leading resources in educating elementary and junior grades about the impacts of climate change. Although the latter chapters have less activities based on the use of scientific method, the resources has made every effort to incorporate scientific data and reasoning in its activities. Its organization also makes it very valuable to teachers by offering accompanying resource sheets for each concept being discussed with the class. It also provides the opportunity for teachers to use the background information in their teachings, yet develop their own activities to conduct with the class.

Summary of Relevance to Community Action:

The final section of this resource is almost completely focused on having students grasp the concept that they have an impact on climate change and everyone has the power to help stop it. Activities in section 5 of this resource are designed to help students feel empowered to affect change in regards to our changing climate. The unfortunate drawback of this otherwise valuable resource is that is has been compiled to best suit communities in the Lake Huron Coastal region. However, it does focus strongly on the effects of climate change in Ontario and uses Ontario's curriculum to reinforce this focus. This resource will be a valuable resource for grade 7 teachers who wish to educate their classes concerning climate change.

3. Background Information:

Resource Title:

Teaching About Climate Change: Cool Schools Tackle Global Warming

Cost:

$15.95

Publisher:

Green Teacher Magazine

95 Robert Street

Toronto, ON

M5S 2K5

and

New Society Publishers

www.newsociety.com

Author(s):

Tim Grant

Gail Littlejohn

Curriculum:

Applicable Grade Levels:

This resource was compiled to reach a wide spectrum of grade levels and in some way may be applicable to ***all elementary and junior grades***.

Curriculum Connections:

This resource provides a curriculum index on page 73 to offers teachers a quick reference to connect the activities in this book with curriculum areas such as Art, Language, Math, Science and Social Studies, among others. Page references are given for each curriculum area and are further categorized according to age.

Curriculum Connections (Science and Tech):

The resource contains a plethora of connections to the science and technology curriculum. There is no reference made to the specific education goals or objectives that

would be covered by conducting these activities, however the use of the curriculum index will help teachers narrow their search for material relevant to the desired subject matter and grade level. For instance a grade 7 teacher wishing to conduct a science lesson that addresses the issue of climate change could use the curriculum index to find a variety of simple activities and experiments on page 11 that are suitable for his/her grade level.

Teaching Materials:

This book is divided into 5 main sections, each of which contains various activities that can be applied to grade levels from kindergarten to grade 12. These five sections are:

- Foundations
- Energy Alternatives
- Transportation Alternatives
- The School Building
- Home and Community

Foundations: This chapter begins by setting climate change into a context that is appropriate for teaching students. As the title suggests, this chapter provides the necessary foundations for teachers without an environmental education background to begin to educate their students on the subject of climate change. This chapter addresses the challenges associated with teaching students about climate change stating that given the complex environmental and social issues that surround the subject, teaching this subject to any grade level requires above all else, patience. The concept of the greenhouse effect is explained in this chapter and is followed with simple activities that can be applied to all grade levels by adjusting the degree of complexity in the lesson and introducing new concepts.

Energy Alternatives: The 'energy alternatives' section of this resource discusses various ways that non-conventional energy sources can be used to help reduce our impact on climate change. The primary focus is on the use of direct and passive solar energy. One section of this chapter offers ideas on how to use a solar panel to demonstrate the ability of the sun to power common electrical appliances. Another section of this chapter

discuses solar cookers and provides instructions on how students may build their own solar cookers. A compilation of short activities divided into curriculum subject matter for Kindergarten to Grade 12 is provided at the end of this section.

Transportation Alternatives: The purpose of this chapter is to get students to consider the plethora of transportation options that exist. The primary focus of this chapter is on buses and bicycles and making the link between using alternate transportation and reducing greenhouse gas emissions. This chapter offers several ideas for activities and events that schools can plan in order discourage the unnecessary (over) use of automobiles. This chapter does an excellent job of encouraging group and community initiatives that will mitigate climate changes. It has a very strong focus on social studies and health education, however it lacks the focus on scientific method/experimentation that the other chapters of this book have displayed.

The School Building: This chapter is relatively shorter than the rest in this resource, however this chapter has a strong scientific focus. The first part of this section offers ideas on ways classes can explore their schools to make them more 'green' inside and out. Simple ideas on how schools can mitigate the impacts of climate change are given throughout the readings. Students are encouraged to explore their school in an energy audit that looks at the use of electricity, heating systems, lighting, transportation, water use and recycling. It should be noted however, that the ideas presented in this chapter are generally things that Peterborough Green-Up has been promoting for several years in the community.

Home and Community: This chapter makes the connection between climate change impacts and actions in the home and community for students. Exercises to explore the consumption of water and energy in the home are presented along with a look at alternative methods of achieving sustainable living practices. "The Clean Air Game" is presented in this chapter, it is a simple board game that uses hypothetical practices that harm or help the environment as the criteria as advancement or penalty in the game. This chapter finishes with a roundtable consensus building exercise designed for grade 5 and

up. This chapter uses little scientific method, however it has a strong focus on comprehending scientific concepts that are necessary for making informed decisions about the environment.

Summary of Applicability to Science and Tech:

This is another resource that has been designed in a way that will allow teachers to easily recognize the curriculum connections for each grade level. The early chapters of this book introduce many key scientific concepts that are central to understanding human impact on climate change and the resulting effects on our environment. On Page 73 the authors clearly define the connections between the activities in this book and relevant areas of curriculum for each grade level. Of all the curriculum subjects this book addresses, Science and Social Studies have the greatest focus; a majority of these activities are for designed grades 4 and up.

Summary of Relevance to Community Action:

The authors of this book have compiled it from the works of other environmental educators. The 2 associated publisher for this book are organizations that are working to improve the quality of 'sustainable living' in our communities. This book was probably compiled for use among Toronto schools and communities, however the ideas presented in this book would also work effectively and would be easier to organize in the Peterborough community. This resource has a strong focus on reducing climate change impact through transportation alternatives. This particular focus may be given more credence in Toronto as traffic is one of that cities greatest environmental impacts. Teachers using this resource should stress to students that their community may not have as many cars as Toronto, but may have a similar impact per capita.

4. Background Information:

Resource Title: Nebraska Earth Science Education Network (NESEN)

Cost: Free. Available on the World Wide Web.

Web Address:

http://nesen.unl.edu

Author(s):

Various Authors

Curriculum:

Applicable Grade Levels:

This website offers lesson plans for all primary and junior grade levels.

Curriculum Connections:

The NESEN website is aimed towards educators teaching the Nebraska elementary curriculum. The lessons and units focusing on climate change all make specific references to science and social studies curriculum for the state of Nebraska. There are many connections that might be made to Ontario's science and technology curriculum for each grade level. For instance, in Ontario's life science curriculum strong connections can be made between these lessons and topics such as Growth and Change in Plants, Diversity of Living Things, Interactions with Ecosystems (***Life Sciences***), Properties of Liquids and Solids, Properties of and Changes in Matter (***Matter and Materials***) Air and Water in the Environment, Weather and The Earth's Crust (***Earth and Space Systems***).

Along with the connections that can be made for Ontario's Science and Technology curriculum a number of connections to social studies based curricula such as Geography also exist. Once again these are aimed to serve the Nebraska education curriculum, but will have strong connections that can be made to Ontario's curriculum as well.

Teaching Materials:

This website is a compilation of lesson plans that have been offered by educators on the World Wide Web. There are several different environmental subjects offered on this

website, with many of these focussing on climate change and subsets of climate change such as global warming, air quality and atmospheric pollution. Lessons of particular interest on this site include:

- Evidence for Trend in Climate Change
- Climate and Atmosphere: A Global and Local Perspective
- How Does Climate and Climate Change Affect You?
- Living in the Greenhouse
- Why Should I Care About Global Warming?

A brief description of these lessons is provided below to offer a sample of the quality of lessons available on the Nebraska Earth Science Education Network.

Evidence for Trends in Climate Change: The lesson is designed for use with grade 8 students and is projected to take approximately 4-6 weeks. The purpose of this unit is to have students explore the ways that proxy data is used to gather evidence of climate change. Examples of proxy data such as ice core sampling, fossil age determination, tree ring chronology and trends from weather almanacs are used to illustrate the trend toward a warming planet that is occurring. Links to appropriate background information and proxy data website are provided with the lesson plan.

Climate and Atmosphere - A Global and Local Perspective: This lesson plan is a collection of activities that help to build fundamental knowledge of climate change and the global and local impacts it will likely have on things such as water, soil and air. It is not stated how long the unit would take to deliver, but does state that these activities are best suited for grade 7 students. This lesson has a particularly strong focus on science and technology, however some concepts may be too complex to adapt to grades below 7 and 8.

How Does Climate Change Affect You? This lesson is designed for use with grade 8 students and is projected to take approximately 4-6 weeks. It begins with explaining the fundamental differences between climate and weather, then branches out to discuss the

differences between natural climate change/variability and human induced climate change. This lesson offers quick links to the connections that are made to the Nebraska Earth Sciences and Social Studies curriculum. Objectives for curriculum content are listed and could be easily adapted to suit Ontario's Science and Technology and Geography curriculum.

Living in the Greenhouse: This unit is designed to suit elementary students and would likely best suit grades 5-7. This unit involves an exploration of real greenhouses and the earth's atmosphere as a greenhouse. Students use common material (recycled and reused preferred) to build their own 'mini' greenhouses and conduct experiment using these greenhouse to learn how a greenhouse functions.

Why Should I Care About Climate Change? Long-term (up to 3-4 weeks) experimentation is used to explore the greenhouse effect and how C02 levels can affect plant growth. Teachers planning on using this unit should set up the plant growing experiment 3 weeks prior to its beginning. A large list of Science and Technology and Social Studies lessons are provided with this unit. Once again, these lessons are designed to suit the Nebraska education curriculum, but could be used to complete specific learning objectives from Ontario's curriculum.

Summary of Applicability to Science and Tech:

This website offers an enormous variety of lessons on a number of different environmental issues. Each of these lessons and units has connections to curriculum objectives for the Nebraska Science curriculum. These objectives do not directly translate to Ontario's Science and technology objectives, but many similarities exist between the two curriculums (see curriculum connections). Unlike many of the other resources examined in the course of this research, these lesson plans and units are solely designed to meet the needs of science and social studies curriculum areas. Most of the lessons on this site are aimed towards upper levels of elementary school and may not be easily applied to younger grades due to complex concepts that would need to be learned and understood prior to engaging in these activities/lessons.

The Nebraska Earth Science Education Network offers this site to serve educators from a wide geographical range. The result of this is no specific references to particular communities, however the lessons and units found on this website are written to promote global awareness and local action in regards to climate change. Although the lessons on this website make strong scientific connections, they do not promote community and individual action as well as other resource examined through the course of this research.

5. Background Information:

Resource Title:

Learning for a Sustainable Future (LSF)

Cost:

Free. Available on the World Wide Web.

Web Address:

http://www.schoolnet.ca/learning/teacher/classroom/content.htm

Author(s):

Various Authors

Curriculum:

Applicable Grade Levels:

This website offers lesson plans for all primary and junior grade levels.

Curriculum Connections:

This web resource has a plethora of curriculum connections that are applicable to the Ontario Science and Technology curriculum. Each lesson or activity offered by LSF has a listing of relevant fields of study. The majority of fields of study listed are scientific including earth/environmental science, chemistry, geography and biology. There are also links made to world issues and other social studies subjects. However, this sight does not make specific references to curriculum objectives that can be accomplished through conducting these lessons. Despite this there are many connections that can be made to specific and overall objectives in the Ontario Science and Technology curriculum. Examples of curriculum ties include, but are not limited to, Interactions within Ecosystems (***Life Sciences***), Weather, Air and Water in the Environment and Daily Seasonal Cycles (***Earth and Space Systems***).

Teaching Materials:

The materials relating to climate change education on the Learning for a Sustainable Future website can be found in an index at the following address

Climate Change Round Table: This activity is suited towards grade 5 and up. It is the same type of activity that is found in *Cool Schools Tackle Climate Change* by Tim Grant and Gail Littlejohn or in *Our Changing Climate* by the Toronto Environmental Alliance.

Cool Schools - What Schools can do About Global Warming: All grade levels in a school can participate in this activity. Learning for a Sustainable Future offers this lesson outline for schools who wish to explore ways to reduce their school's impact on climate change. Energy and schoolyard audits are suggested making this activity similar to school audits that have been presented in nearly all the resources reviewed.

Summary of Applicability to Science and Tech:

This lessons and activities offered on this web site provide ideas and tentative outlines for teaching subjects related to climate change. This site is heavily weighted towards science based activities. Supporting material for the lessons plans such as video and internet resources are provided, however there is no way to guarantee the consistency of these web links. Should these sights be unavailable, the information and supporting activities contained in *Cool Schools Tackle Climate Change* by Tim Grant and Gail Littlejohn, *Our Changing Climate* by the Toronto Environmental Alliance and *Changing Our Future Kit* from the Lake Huron Centre for Coastal Conservation would be more than sufficient to conduct the activities suggested by LSF.

Summary of Relevance to Community Action:

As is the case with the resources that show similarities to LSF's posted activities, there are components to this resource that will help an understanding of climate change, it's impacts and possible ways to mitigate it spread throughout the community, using the classroom as it's starting point. Please note that this site does not have many original or new ideas for teaching about climate change. The lessons and activities available on this website are very similar to the lessons and activities found in other resources.

(http://www.schoolnet.ca/learning/teacher/classroom/thematic/climate/chart.htm). Topics lesson and activities relating to climate change include:

- Climate Change: A Proposed Unit of Study
- Mayonnaise Jar Greenhouse
- Carbon Dioxide and the Greenhouse Effect
- Climate Change Round Table
- Cool Schools: What Schools can do About Global Warming

A short description of each of these units/lessons is given below:

Climate Change - A Proposed Unit of Study: This unit is aimed at grades 7 &8 and seeks to clarify common misconceptions about climate change and discusses the factors that dictate climate and possible effects of a changed climate. Suggestions are made for appropriate print, video and Internet resources to support the outline of this lesson.

Mayonnaise Jar Greenhouse: This is an activity that uses mayonnaise jars to demonstrate the greenhouse effect in ways similar to activities such as *Living in the Greenhouse* from NESEN, or the mayonnaise jar experiment found in the Human Influence on Climate Change (Section 5) activities for the *Changing Our Future Kit* from the Lake Huron Centre for Coastal Conservation.

Carbon Dioxide and the Greenhouse Effect: This lesson uses 2 soda bottles to demonstrate the effects of C02 as a greenhouse gas. One bottle is filled with C02 and the other left with oxygen; temperatures are recorded to compare the differences in temperatures. This lesson can be adapted for any grade level. On it's own, this lesson would have little effectiveness in explaining the greenhouse effect and how it relates to global warming, however as part of a series of experiment or lessons in a unit it is a great experiment that introduces students to using controls, gathering data and interpreting data.

Summary of Applicability to Science and Tech:

This resource make be lacking in activities that involve scientific experiment, but it can still serve as a valuable supplement to lessons and units on climate change and global warming.

Summary of Relevance to Community Action:

One of the links on the site titled "We can make a difference" informs students on ways they can reduce their personal impact on global warming by encouraging changes to personal actions and attitudes.

6. Background Information:

Resource Title:

The Environmental Protection Agency (EPA) Global Warming Kids Page

Cost:

Free. Available on the World Wide Web.

Web Address:

http://www.epa.gov/globalwarming/kids/index.html

Author(s):

The EPA

Curriculum:

Applicable Grade Levels:

All Grade levels could find this site to be useful for understanding global warming and its effects on climate change, however this page seems to be aimed towards a younger audience (***Grades 6 and lower***).

Curriculum Connections:

There are no specific references made to specific or overall objectives for any particular curriculum. The site could best serve as a tool for students to explore the intricacy of the subject in a fun and interactive manner. If curriculum connections were available they would most likely suit curriculum guidelines from the United States.

Teaching Materials:

The EPA Global Warming Kids Page is designed with several links for students to self guide themselves though this page. There is little to no material that would be translated into lessons or curriculum based units on this web site. However, students could be given assignments or independent study projects in which they must summarize a component of the site and relay that information to the class or a smaller group. There is also a games section that teachers could encourage students to use when they have completed their regular class work.

hours you plan to commit to this practice. The result is a tally of the amount of CO2 you will save from your 'pledge.' The game continues with trivia based questions about climate change. Teachers may register their class with CO2 Challenge.Com so students can play the game and compete with other students across Canada for prizes.

A teacher's resource section is provided by CO2 challenge.com to assist teachers in integrating this activities and software on this website into their own lessons plans and climate change units. Connected to the teacher's section of this resource is a list of activities that teachers may choose to use as assignments for their class. These activities have been developed to help address the following questions: What is climate and does it change? How can human activity be linked to climate change? What are the potential effects of climate change? How can people's action reduce global greenhouse gas emissions?

Summary of Applicability to Science and Tech:

The entire educational focus of this website can be applied to the scientific curriculum. It attempts to de-mystify the subject of climate change through engaging software and other activities. This website will be an excellent resource for those wishing to incorporate the subject of climate change into their lesson planning and who require a fun and interactive tool as an extension of regular teachings.

Summary of Relevance to Community Action:

This website make no connections to any one particular community. It's focus is on encouraging visitors to the site to make informed decisions relating to reducing climate change. Any teacher in any community across Canada will be able to incorporate the material on this website to benefit their class and encourage community action.

7. Background Information:

Resource Title:

CO2 Challenge.Com:

Cost:

Free. Available on the World Wide Web.

Web Address:

http://www.co2challenge.com/index_good.htm

Author(s):

Unknown

Curriculum:

Applicable Grade Levels:

The CO2 Challenge website makes curriculum connections for nearly every grade level, however, the activities that are linked to the teacher's section of the site fit into ***3 main grade categories 4-6, 7-9 and 10-12.***

Curriculum Connections:

One of the features of this website is that it makes available curriculum connections in the forms of learning objectives and rubrics for use by teachers. A listing of the curriculum based goals and objectives that can be achieved through the use of this website is organized by province and grade level. The science curriculum is the only curriculum that this website make connections to, but it makes several relevant connections within this curriculum regarding ***Life Systems***, ***Habitat and Communities*** and ***Energy and Control.***

Teaching Materials:

The CO2 challenge is open to all Canadians and offers 3 different categories (Student, Public and Group) for people who wish to take the challenge. When you activate the game on the main page the site gives you a list from which you select one CO2 emission reducing practice to apply in your life. You also state how many times or for how many

7.b) The Global Warming Wheel Card Classroom Activity Kit: The Global Warming Wheel Card Classroom Activity Kit is a resource designed to provide a fast and easy way for students to calculate their personal greenhouse emissions. The kit includes a set of wheel cards that can be used with 3 "hand-on" activities and one homework assignment that helps explain global warming. This kit has been assembled by the EPA for use among Grade 6,7 and 8 students.

Curriculum Connections:

The Global warming wheel kit is produced by the EPA and therefore does not incorporate any specific curriculum goals or objectives that would be relevant for Ontario science and technology, or other curriculums. The objective of this kit is to have students consider their personal impact on greenhouse emissions, a goal that is better accomplished for Canadian students using the climate change calculator.

7.c) Canadian Environmental Education Curriculum Assessment Program: This website offers a searchable database of lessons and activities that relate to various components of environmental education. Search criteria may be entered to locate material relating to all subjects of ecological education, this search can be further narrowed by selecting grade levels (1-12) and associated provinces.

Curriculum Connections: Along with the ability to search this website database for subject matter related to climate change you may also select from one of 4 different curriculum streams: Health and Physical Education, Practical and Applied Arts, Science and Social Studies. A quick search on climate change lessons in Ontario provides 19 results that can be directly applied to Ontario's science and technology curriculum.

8. Miscellaneous Resources

Along with organized education kits and Internet resources, a small number of valuable miscellaneous resources and activities are available on the World Wide Web to supplement lesson planning and to help stimulate the creative process when organizing lessons or units based on climate change. The most predominant, relevant and useful of these resources for the Ontario Science curriculum include:

- The Climate Change Calculator
  http://www.climcalc.net/
- The Global Warming Wheel Card Classroom Activity Kit
  http://yosemite.epa.gov/oar/globalwarming.nsf/content/VisitorCenterEducators.html
- Canadian Environmental Education Curriculum Assessment Program
  http://www.ceecap.com/main.php

7.a) The Climate Change Calculator:

The Climate Change Calculator is a software tool that can be used to calculate personal C02 emissions. The software asks several questions concerning personal practices that result in the release of greenhouse gas into the atmosphere, such as km driven or hours of electricity used per day. The calculator can be used live over the Internet or by downloading it to a computer's hard drive. After the calculator asks a series of questions concerning personal impact on climate change, it compares your results to the average emissions per capita for the province and country and suggests ways for you to reduce your impact.

Curriculum Connections:

Curriculum links and suggestions for incorporation of the Climate Change Calculator into lesson plans and classroom activities are currently being developed. These are expected to be available by the end of the summer, 2003.

a scientifically responsible way. Teacher's choosing to use these resources would be wise to use a combination of them in order to ensure the topic is covered in a cosmopolitan fashion.

Each resource described in the teaching material assessment has its own strengths and weaknesses. However there are 2 resources that have stood above the others that are currently available, these are the Changing Our Future kit and the C02 challenge.com. These resources are the most applicable to Ontario's science and technology curriculum with defined goals and objectives that have been developed directly from the new curriculum. The only con associated with either of these resources is that they do not apply directly to the Peterborough community. This is not to say applications cannot be made, however the Changing Our Future kit was developed to serve communities along the coast of Lake Huron.

Teachers seeking resources such as these to develop climate change lessons are likely to fit into one of two descriptions, little or no scientific knowledge of climate change ***and*** basic to expert scientific knowledge of climate change. For educators with background knowledge on the subject, these materials may only be useful in that they can stimulate the creative process or offer new ideas for communicating the topic. However, for educators with little or no background knowledge on the subject, resources such as the Changing Our Future Kit and the C02 challenge.com will be extremely useful in developing lessons that will be the goal and objectives of Ontario's science and technology curriculum.

Project Summary:

There are a wide variety of resources available to educators wishing to communicate the issue of climate change in their classroom. Many of these resources are available on the World Wide Web, but determining their usefulness for elementary grade levels in Ontario can be overwhelming. During the course of this research many 'personally published' lessons were found available on the Internet. Although these lessons, activities, crafts and games can be applied to teaching about climate change, they often lack in use of scientific methods. Some of these resources even take on an air of fear mongering in their explanations. While educating students of any age about climate change it is important to avoid the use of scare tactics. For instance, telling students that the coastlines of North America will be swallowed by seawater when the ice caps melt would be considered fear mongering and irresponsible use of modeled data. On that note, educators should also make the effort to explain to students that the information we use to predict the effects of climate change come from mathematical models that project possible climate scenarios based on doubling atmospheric C02 concentrations and the subsequent warming from increased greenhouse gas concentrations.

Educators planning on using the resources described in this research will find that, together these resources can cover virtually any topic relating to climate change and offer suggestions on how to teach/communicate that information to students. None of these resources can be considered an exceptional stand-alone resource for teaching climate change, yet combining the use of these resources in lesson planning would be an excellent way to be sure a spectrum of climate change issues are taught and addressed in