Our Changing Climate

Learning How to Take Charge of Climate Change at School, Home and in the Community

Junior Level Curriculum Unit

tea
Toronto Environmental Alliance

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Acknowledgments

This unit was produced by Youth Educators for Environmental Action and the Energy and Climate Change caucus of the Toronto Environmental Alliance. Thanks all of you who provided, advice, insight, resource materials and a supportive hand to the writers of the unit:

Ross Briethaupt, Grade Five Teacher; Anne Cirillo, Math Consultant for Metro Separate Board of Education; Lois Corbett, Executive Director of TEA; Tim Grant, Editor of Green Teacher Magazine; Anne Hofland, Teacher-Librarian at Parklands P.S.; Ruth Oppenheim, Arts Consultant for York Region Board of Education; Raquel Roizman, York Education Student; Marichu Silot; Keith Stuart, TEA member; Stephanie Thorson, TEA staff; John Wellner, TEA staff; Janet May, TEA staff; John Tersigni, Director of The Green Brick Road; Energy Educators of Ontario; and Greensaver.

Special Thanks to Our Field Test Team...

We formed a field-test team from a range of School Boards and grade levels with the goal that this unit will have widespread use in Ontario schools. These teachers assisted in the development of this unit by testing it in their classrooms over a span of four months. Their feedback was extremely helpful during the final revisions. Their practical comments and suggestions are reflected throughout the unit.

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York Region Board

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Funding Contributors

Get Up Stand Up
Trillium Foundation

Environmental Youth Corps (EYC)
Ministry of Environment and Energy

Environment Canada

The Learnxs Foundation

The Toronto Atmospheric Fund

Foreword

"Not knowing is terrifying and knowing is terrifying;
but not knowing is hopeless and knowing may save us."

A grade 8 student

Dear Educators, Parents and Students,

Welcome to the Toronto Environmental Alliance's (TEA) proactive climate change curriculum. We believe that this unit is very special, because it was designed and created by youth for youth.

A group of Education and Environmental Studies university students called Youth Educators for Environmental Action, the youth wing of TEA, developed *Our Changing Climate* as a way to empower young students to take action in their own homes and communities to reduce greenhouse gas emissions and stop climate change.

While designing this unit, Youth Educators consulted and worked with a number of educators around Toronto to find out how we could make this unit useful and worthwhile for teachers trying to meet regular curriculum guidelines. As a result, *Our Changing Climate* is a cross-curricular unit that approaches climate change from a range of subjects including language, arts, mathematics, science, geography, history, and computers. The unit contains interactive and hands-on activities to encourage active learning.

Why a climate change curriculum unit? More than 90 percent of the human-made carbon dioxide currently in the atmosphere comes from Europe and North America. Along with many other countries in the developed world, Canada is committed to stabilizing carbon dioxide emissions at 1990 levels by the year 2000. The City of Toronto and Metro Toronto are aiming to reduce carbon dioxide emissions by 20 percent of 1988 levels by the year 2005. *Our Changing Climate* was developed to help fulfill both emission reduction targets.

TEA is a non-profit, non-governmental organization that provides opportunities for Metro Toronto citizens to work together to develop local solutions to environmental problems. We want local governments to reduce their greenhouse gas emissions and have developed a number of steps to ensure these reductions occur through active public participation. Through this educational initiative, we hope students will attempt to make real changes in reducing their communities' contribution to greenhouse gas pollution and learn how to make a positive impact in this world.

We know this unit will be fun and educational for all - please keep it alive!

Happy learning,

Lois Corbett
Executive Director
Toronto Environmental Alliance

Samantha Berman
Our Changing Climate Author
Youth Educators for Environmental Action

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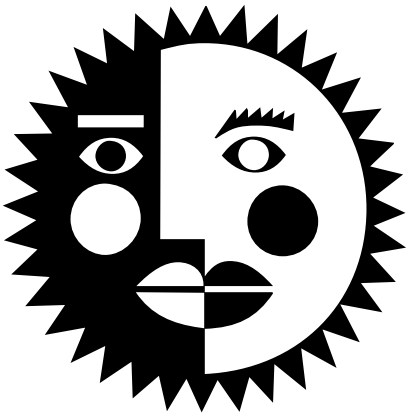
PART ONE



Introduction

Our Changing Climate is a curriculum unit on climate change designed for students and teachers in junior level classes.

The lessons in this unit are organized into six chapters found in Part II.After completing Chapter One on the greenhouse effect, the chapters are designed in a way that teachers have the flexibility to pick and choose which chapters they wish to use, depending upon time and student interest.

The purpose of these activities is to increase the awareness and knowledge of students regarding the issue of climate change. As well, the unit is intended to update attitudes while complementing educational skills in an interdisciplinary setting and encouraging students to participate actively in the solutions to climate change.

Although the first priority of this kit is as an educational unit, it is also fun and creative for both students and teachers. The activities range from students conducting various greenhouse experiments, planning an investigation to see if their school is atmospherically friendly or not, comparing energy use in the past to the present, designing an energy-saving action plan, participating in a mock round table climate change discussion, creating a transit-centered community and much more!

Organization

Part I of Our Changing Climate consists of essential information for the teacher. It includes learning outcomes according to *The Common Curriculum,* this overview, and an article that covers background material on climate change.*

Part II consists of all of the LESSONS and HANDOUTS. There are nineteen lesson plans in total, and they are divided into six chapters. Each chapter begins with an overview page that lists all the lessons in that chapter with brief descriptions,and chapter outcomes are included at the bottom. Handouts are included after each lesson, and they are labelled by a different font that will say HANDOUT 1-A. The '1' indicates the corresponding lesson, and the 'A' indicates the order of the handouts in the lesson. Extension activities can be found in the APPENDIX, unless specified otherwise.

The lesson plans are user-friendly with all the information you need right in front of you. You can teach the lesson exactly as it is set before you, or you can modify it according to the level of your class. The lessons are divided into chapters that are easy to identify. The lesson plans are set up in this order:

Summary - quick explanation of the activity;

Length - approximate time length;

Outcomes - lesson specific outcomes;

Materials - list of materials, HANDOUTS, and setting if outside of classroom;

Background - rationale behind the lesson and/or further explanation for the teacher;

Procedure - step by step lesson directions;

Closure - summary discussion or wrap-up activity;

Extension - either an additional lesson, an extra activity for quick students, or a homework assignment.

* *This will be updated when Ontario's curriculum guidelines change.*

The following are short descriptions of each chapter:

Chapter One Students explore the earth as a system and learn about the greenhouse effect, greenhouse gases and the potential impacts of climate change through simple experiments, diagrams, map work and artistic representations.

Chapter Two Students conduct a secret school transportation audit to find out if their school is atmospherically-friendly by comparing the amount of carbon dioxide produced by getting to and from school and the amount of carbon dioxide absorbed by trees on the school grounds.

Chapter Three Students read a story that compares energy use in the past to the present. The concept of energy-efficiency is introduced, and students design an energy-saving action plan for their home.

Chapter Four Energy sources are discussed according to their advantages and disadvantages. Small research groups study a renewable energy source and design a commercial to promote their energy source to the class. Persuasive techniques in TV are critically analyzed.

Chapter Five The round table method is used to discuss a policy-oriented solution to climate change. Students adopt the roles of different interest groups and negotiate to arrive at a consensus for action.

Chapter Six Climate change issues are explored from a global perspective by reading about different cities' initiatives to combat climate change and plotting them on a map. Students rank the top 12 countries' total greenhouse gas emissions and per capita greenhouse gas emissions and discuss the differences. Students design their own transit-oriented community.

Part III includes the GLOSSARY, APPENDIX and the RESOURCE section. The GLOSSARY consists of key terms and definitions. Inside the APPENDIX, a Unit Test is available that is full of sample test questions covering the whole unit. Teachers can use the Unit Test to design their own test that reflects the chapters they covered in class. The APPENDIX also holds the Parent/Guardian Letter that explains the upcoming unit to parents, as well as the extension activities, most of which are suggested at the end of individual lessons. A list of eight steps for teachers and students who want to take more action outside of the classroom is also included. The RESOURCE section is a thorough list of books, videos, and speakers for the teacher looking for additional information, complementary resources or field-trips.

Learning Outcomes

The lessons in Our Changing Climate fulfill subject areas and learning outcomes as outlined in the Ontario Ministry of Education's *The Common Curriculum*. For your convenience, we have created two charts that link the individual lessons to The *Common Curriculum's* essential and specific outcomes.* Please see the following pages for details. Our own distinct outcomes can be found at the beginning of each chapter and lesson.

* *This will be updated when Ontario's curriculum guidelines change.*

S*ubject areas* that are cov ered in the v ar ious learning activities include:

- Art
- Creative Writing
- Geography
- Language Arts
- Photography
- Science and Technology
- Communications
- Drama
- History
- Math
- Media
- Social Studies

***Skill areas* that are strengthened by using this unit include:**

- Analyzing
- Calculating
- Charting
- Communicating
- Critical Thinking
- Dramatizing
- Graphing
- Experimenting
- Hypothesizing
- Identifying
- Listening
- Manipulating
- Measuring
- Observing
- Brainstorming
- Classifying
- Collecting
- Comparing
- Data Collecting
- Generalizing
- Group Work
- Following Directions
- Inferring
- Interpreting
- Listing
- Mapping
- Media Constructing
- Predicting
- Presenting
- Reading
- Record Keeping
- Surveying
- Problem-Solving
- Reasoning
- Researching
- Writing

Evaluation

The evaluation of this unit is ongoing. A final written test is only one means of assessing student progress after the unit is completed.

Some suggested evaluation techniques to use during the unit include:

Chapter One

The experiments conducted in Lesson 3 and 4 can each be evaluated according to any marking scheme. This evaluation should include how well students operate in a group.

In Lesson 6,students are asked to compose two visions of the future; one optimistic and one pessimistic. These creative writing pieces can be marked.

Chapter Two

Students maintain a daily log of their activities in answering the School Transportation Audit question.

At the completion of this section, students will hand in an API Report consisting of all the HANDOUTs and notes they make during their investigation. The outline for the report submission is found in Lesson 10.

Chapter Three

In Lesson 12, students create their own time-line for how they use energy in a typical day. Students can also interview adults on energy use in the past, and speculate how they will use energy in the future.

Chapter Four

The energy commercials presented in Lesson 16 can be assessed through peer evaluation. An evaluation form is included with the lesson. Each group should also evaluate themselves.

Chapter Five

Students can be evaluated on the depth of thought of their presentations and how well they deliver their argument.

Chapter Six

Each of the HANDOUTs can be marked for accuracy and completion. In Lesson 18, HANDOUT 18-D: Category Conundrum can be scored out of 24 marks, one mark for each correct response. In Lesson 19, the 'Transitville' Map can be marked on the basis of whether or not the planning group used sustainable concepts learned in class, as well as their originality. When students present their 'rationale' to the class regarding their planned community, they can be marked according to their own explanation (can they articulate their reasons for planning their community in that way)?

Learning Activities under The Common Curriculum* Areas

**This applies to the exisiting curriculum in the province of Ontario and will be adapted when this changes.*

Math, Science and Technology

- collect data in the community
- data manipulation
- graph data
- multiplication of 2 digit numbers
- mapping
- observation
- experiments
- computer spreadsheets

Personal and Social Studies: Self and Society

- identify cities on a map
- understand other cities' initiatives to stop climate change
- design a transit-centred community
- rank countries by greenhouse gas emissions

Subject Integration
Global Climate Change

Language

- reading for information
- creative writing
- writing experimental reports
- media literacy (persuasive techniques in TV ads)
- oral presentations
- letter writing
- read a novel The Crystal Drop about global warming and ozone depletion

The Arts

- draw an example of a system
- sketch and/or photograph environmental practices in the neighbourhood
- produce a TV advertisement for energy source
- design a poster/web page educating the public about climate change
- class mural to educate others
- design an international greenhouse logo
- design a display for alternative energy sources

Applying The Common Curriculum* to Our Changing Climate

**This applies to the exisiting curriculum in the province of Ontario and will be adapted when this changes.*

This unit addresses a number of essential and specific outcomes from The Common Curriculum. On pages 9 and 10, two charts are provided to help you link the essential and specific outcomes to each lesson.

The **essential outcomes** addressed are as follows: Students will:

1. **communicate effectively;**
   - a. demonstrate literacy and numeracy skills, including the ability to use appropriate conventions, symbols, and systems;
   - b. use the language, models,and symbols of all program areas effectively and appropriately;
   - c. demonstrate sensitivity to the effect of language, symbols, and communication methods on audiences and on human activities in general;
   - d. use a variety of forms,media, and languages to communicate ideas, experiences, and feelings.

2. **solve problems and make responsible decisions using critical and creative thinking;**
   - a. raise questions and pursue creative solutions using a variety of strategies;
   - b. conduct an inquiry with integrity and discipline;
   - c. use a variety of services and resources in the school, the community, and the broader society to gather and evaluate information;
   - d. evaluate their problem-solving strategies and determine ways of improving them.

3. **use technology effectively;**
   - a. use a wide range of processes, techniques, tools and materials to gather information, solve problems, create and evaluate products, and communicate results;
   - b. use technology safely and ethically at school, at home, and in the workplace;
   - c. demonstrate the ability and willingness to evaluate the influence of technological developments on people, communities,and the environment.

4. **demonstrate an understanding of the world as a set of related systems;**
   - a. use appropriate ideas, models, and theories to investigate and describe the natural and human-made worlds;
   - b. evaluate the interdependence of local, national, and global communities and their dependence on the environment;
   - c. analyze the causes and effects of power relationships within groups in their immediate environment, the larger society, and the international community.

5. **apply the skills needed to work and get along with other people;**
   - a. work collaboratively and effectively with others on a common task;
   - b. demonstrate understanding of the ways in which individuals' family background, language, and culture influence their ideas and behavior;
   - c. resolve conflicts in peaceful, co-operative, and equitable ways.

6. participate as responsible citizens in the life of the local, national, and global communities;
- **a.** contribute constructively to the life of the classroom, the school,and the community;
- **b.** pursue excellence and originality in their own work and support these qualities in the work of others;
- **c.** demonstrate concern and care for the environment.

7. explore educational and career opportunities;
- **a.** demonstrate awareness of their personal values, strengths, abilities and aspirations, and an understanding of how these will influence their future choices and opportunities;

8. apply aesthetic judgement in everyday life;
- **a.** demonstrate awareness of aesthetic values in their everyday life;
- **b.** apply aesthetic criteria in producing and evaluating work in a variety of media;
- **c.** describe and evaluate their feelings and thoughts about the natural world, their own work, and the work of others.

9. make wise and safe choices for healthy living;
- **a.** use self-knowledge as a basis for decision-making;
- **b.** demonstrate the ability to reflect on their experiences and learn from them;
- **c.** demonstrate the ability to respond to change in a positive manner.

10. use the skills of learning to learn more effectively.
- **a.** set appropriate goals for their learning, make realistic plans, and keep track of and evaluate their progress;
- **b.** clarify their ideas by reflecting on their own thinking and the responses of others;
- **c.** describe the connections among various ideas and concepts.

The **specific outcomes** addressed are as follows: By the end of grade 6, students will:

The Arts

A13 – use skills developed through experiences in the arts in other program areas;
A18 – identify problems such as stereotyping and prejudice presented in specific works of art;
A19 – explain the reasons for their ideas and opinions about the arts, show respect for others' ideas, and use problem-solving skills in creating and presenting works of art;
A22 – use techniques specific to each of the arts to express ideas and feelings;
A26 – use various types of technology in creative activities in the arts;
A28 – create arts works that express their thoughts on environmental issues.

Language

L2 – consistently respond to more complex instructions, questions,and directions;
L3 – show sensitivity to the needs, rights, and feelings of others in the use of language during group work;
L4 – use language to learn and communicate ideas in social interaction and group activities;
L8 – use a variety of strategies to read and respond to texts;
L9 – apply a variety of reading strategies to improve their understanding of a text;
L21 – use a wider range of forms in their own productions;
L22 – identify and analyze the ways in which program content and commercials in television are geared to the target audience;

L23 – describe how different elements in media texts help to create atmosphere and shape meaning;
L24 – ask questions about the intended message of a media text and state opinions about the content and form;
L32 – use different forms of communication to express their thoughts and feelings, explain their actions, and affirm their identity.

Mathematics, Science and Technology

M4 – use co-ordinate systems to describe locations of points and figures;
M6 – use tools and materials in investigating and explaining natural and human-made phenomena;
M8 – select appropriate calculation methods to solve problems with whole numbers, fractions and decimals;
M9 – estimate, measure and/or calculate, and record temperature, times, length, perimeter, area, capacity and volume, mass, amounts of money, distance, and speed, using appropriate units of measurement;
M10 – describe the characteristics of one or more forms of energy and use practical examples to demonstrate how energy is transformed;
M18 – analyze the interrelationships of the parts of different systems and the people who work in them;
M25 – experiment with some cause-and-effect relationships and describe their findings;
M27 – investigate the influence of technologies on human and natural communities;
M29 – use different methods of inquiry to solve a variety of problems in mathematics,science, and technology;
M30 – investigate phenomena in their immediate environment and beyond and communicate their findings, working both alone and with others;
M32 – conduct investigations with accuracy, thoroughness, persistence, creativity, and honesty;
M33 – examine different explanations of and solutions to a problem, determine their validity, and apply the most appropriate solution;
M37 – work willingly alone or with others, as required by the project;
M38 – use skills and knowledge from mathematics,science, and technology in conducting investigations at the community level;
M41 – explain how the cultural, professional, and gender-related perspectives of various people may account for different explanations of the world around them;
M45 – explain the connections between the way people live and work, technology, and the environment;
M46 – identify environmental problems in the school and community, recommend solutions, and communicate the solutions effectively.

Personal and Social Studies: Self and Society

P15 – perform an activity that demonstrates awareness of their responsibilities as citizens;
P19 – describe the relationship between people of different types of societies and the natural environment throughout history;
P25 – analyze the reasons for the different responses of people to a local issue;
P33 – describe the purposes and operations of different institutions in Ontario;
P34 – identify a variety of cycle and patterns in their community or the region;
P36 – identify and explain activities that are designed to protect the environment of the community;
P37 – analyze ways in which human and natural systems are connected;
P38 – identify regional and national natural responses, and describe how they are harvested or extracted, processed, and used;
P43 – use a variety of forms and media to communicate ideas and the results of research.

Table 1 – **Individual Lessons According to *The Common Curriculum Essential Outcomes***

Lesson	1a	1b	1c	1d	2a	2b	2c	2d	3a	3b	3c	4a	4b	4d	5a	5b	5c	6a	6b	6d	7a	8a	8c	8d	9a	9b	9d	10a	10b	10c
1				X								X	X	X	X								X							X
2			X												X									X						
3									X			X																		X
4									X	X	X	X			X					X										
5											X									X					X				X	X
6				X							X								X	X										X
7					X	X						X						X										X		
8	X					X																								
9						X	X								X							X								
10								X					X													X				X
11									X																					X
12											X					X*					X									X
13										X								X		X	X						X	X		
14															X										X			X		
15		X								X					X				X				X		X					
16			X							X									X				X		X					
17					X			X	X		X		X	X			X									X	X	X		
18											X				X															
19									X				X		X								X							

* *Under Lesson 12, essential outcome 5b refers to the extension activity.*

Table 2 – **Individual Lessons According to *The Common Curriculum Specific Outcomes***

Lesson	A 13	A 18	A 19	A 22	A 26	A 28	L 2	L 3	L 4	L 8	L 9	L 21	L 22	L 23	L 24	L 32	M 4	M 6	M 8	M 9	M 10	M 18	M 25	M 27	M 29	M 30	M 32	M 33	M 37	M 38	M 41	M 45	M 46	P 15	P 19	P 25	P 33	P 34	P 36	P 37	P 38	P 43	P 44
1							X					X																				X											
2				X		X							X																X											X			
3																		X		X			X			X														X			
4								X	X									X		X			X			X																	
5																							X	X								X											
6						X										X																											
7																									X		X		X														
8																	X		X	X							X																X
9	X																									X				X			X					X					
10							X																																X	X			
11																	X															X											X
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13																										X		X				X	X	X					X				
14										X	X										X			X					X			X			X					X	X		
15		X				X							X	X	X																												
16			X		X							X	X		X	X																										X	
17							X	X	X													X									X		X			X	X						
18																	X												X										X				
19							X	X																					X										X			X	X

Background Material on Climate Change

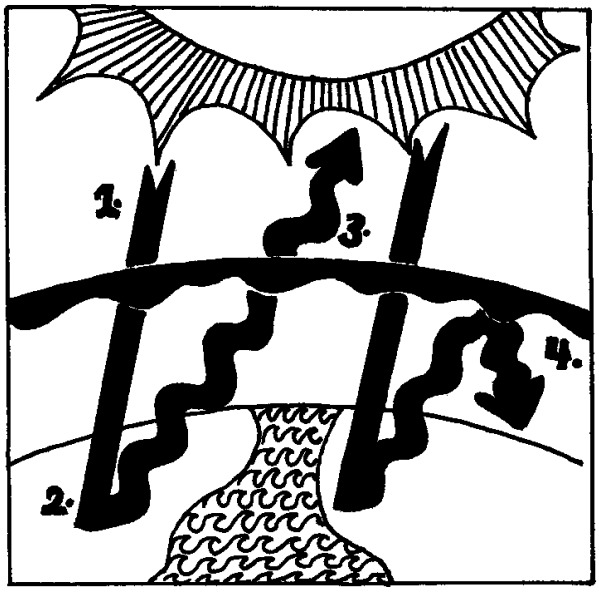
"Climate change refers to the warming of the earth's atmosphere
caused by human-generated emissions of greenhouse gases,
the largest contributors being carbon dioxide, nitrous oxide and methane"
(International Council for Local Environmental Initiatives Report, 1995).

What is the Greenhouse Effect?

The Greenhouse Effect is a natural process. Greenhouse gases like carbon dioxide, methane, nitrous oxides, and chlorofluorocarbons act like a greenhouse, trapping the sun's heat and keeping the Earth warm. Figure 1 illustrates what happens when the sun's light rays enter the atmosphere:

1. Sun rays enter the atmosphere.
2. Light is absorbed by the earth and converted into heat.
3. Some reradiated heat escapes into space.
4. Reradiated heat is trapped by greenhouse gases.

Greenhouse Effect Figure 1



Dark surfaces like city pavement are very good at absorbing heat, that is why temperatures in cities are usually higher than rural areas. Light surfaces like water bodies (lakes, oceans, clouds, and ice caps) reflect light rays from the sun and heat from the Earth.

Although, greenhouse gases only make up *one percent* of the Earth's atmosphere, they act as an insulation blanket for the Earth.

Historically, a natural balance between sunlight entering and heat escaping the atmosphere existed. In the past, temperature and carbon dioxide levels changed very slowly allowing life on Earth time to adapt.Over the last 200 hundred years, however, human activity (mainly through industrialization and population increase) has created a significant increase in greenhouse gases causing an intensified greenhouse effect. In turn,the atmosphere's heat retaining ability has increased, meaning that step #4 on the diagram is occurring at an unprecedented rate.

Scientists fear an increase of only a few degrees Celsius in the global average temperature due to human activity could have a devastating effect on the environment.If the build-up of greenhouse gases continues, the average warming temperature may make it unbearable for life as we know it to exist.

What is the Difference Between *Global Warming* and *Climate Change?*

Many people get confused over the difference between *global warming* and *climate change*. Essentially, they both occur as a result of the same problem - an intensified greenhouse effect. *Global warming* refers to the increase in the Earth's average temperature as a result of an increase of greenhouse gases in the atmosphere. However, as scientists began to realize that the global warming phenomenon did not mean merely an even warming over the globe, they replaced it with the term *climate change* since it better represents the problem. *Climate change* refers to both warming and cooling conditions. As a result of climate change, different areas of the globe will experience more extreme weather events, such as increased rainfall, more storm activity, ocean levels rising, flooding, increased frequency of heat waves or extended drought periods. Some regions will benefit from warmer temperatures, but most will be negatively affected. Lastly, climate change is unpredictable, making it difficult for people to prepare for these extreme weather events and very costly to repair the damages.

Some examples of extreme weather events as a result of climate change include:USA, Dec. 1987 - Arizona's first white Christmas; Bangladesh, Sept. 1988 - 3000 die in storm and tidal surges; 1989 China - worst drought in centuries; 1992 Hurricane Andrew in Florida;USA, 1993 - Great Mississippi Flood causing an estimated US$12 billion in property damage and crop failure; Canada, 1996 - Saguenay flood in Quebec; Canada, July 1996 - Hailstorm in the Prairies costing over $60 million in damages; Canada, 1997 - Red River flood in Manitoba forcing thousands of Winnipeg residents from their homes; and increased forest fires across Canada.

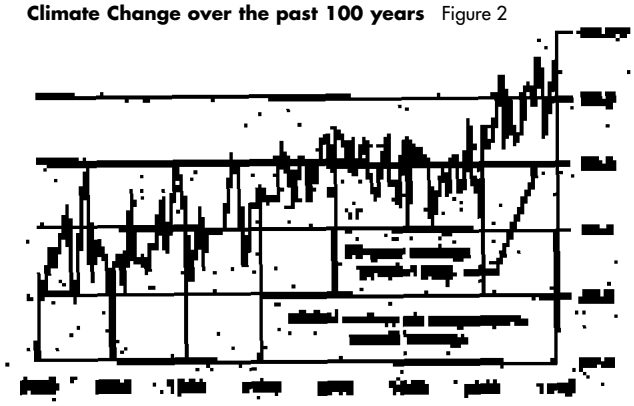
Thus, in this unit, we use the term climate change to describe what is happening in our atmosphere.

Why is Climate Change Happening So Fast?

In May 1990, 300 international experts reporting on behalf of the official United Nations Intergovernmental Panel on Climatic Change said they were "certain that man-made emissions are substantially increasing the atmospheric concentrations of the main greenhouse gases" and added: "These increases will lead to a warming of the earth's surface." Five years later, at the end of 1995 - the warmest year ever recorded - the world's top climatic scientists met in Rome, Italy and concluded that,"the balance of evidence suggests a discernible human influence on global climate."

As a result of an intensified greenhouse effect, the average global temperature is expected to rise 0.3°C per decade or 1.5 - 4.5°C over the next 50 years, making global temperature higher than at any time in the past 10,000 years. This rise in temperature is significant when you compare it to the 0.5°C increase observed over the past 100 years. No one has yet been able to prove whether this increase is the direct result of a human-made greenhouse effect or simply due to natural variations in climate. Yet we cannot ignore that global average temperature increases correspond with the increase of greenhouse gases over the period. In order to understand the severity of these seemingly slight temperature increases, consider that temperatures in the last Ice Age were only 5°C below today's temperature averages. If a difference of 5°C can cause an ice age, it is frightening to think what it will be like to live on an Earth that is another few degrees hotter.

Climate Change over the past 100 years Figure 2



Greenhouse Gases

Fortunately, scientists are sure about something. The human sources of the various greenhouse gases are well understood. On a molecule for molecule basis, each of the different greenhouse gases has a different potential for contributing to climate change. For example, each molecule of methane is the equivalent of 27 carbon dioxide molecules, whereas each molecule of chlorofluorocarbons is equal to 10,000 carbon dioxide molecules.

Canada is the second highest per capita producer of greenhouse gas emissions among major industrialized nations (that means that per person we emit a lot of greenhouse gases!). The main gases that contribute to the greenhouse effect are:

Carbon Dioxide (CO_2)

CO_2 is the largest greenhouse gas by volume and accounts for over half of the warming. The concentration of this gas in the atmosphere has rapidly increased over the past 200 years (historical CO_2 concentrations are determined by analyzing air bubbles in ice cores). The major source of human CO_2 emissions is energy consumption. Burning fossil fuels emits approximately 7.5 billion tonnes of CO_2 into the atmosphere every year worldwide. Canadians emits an annual 500 million tonnes of carbon dioxide, accounting for 80% of Canada's greenhouse gas emissions. Large emissions of carbon dioxide also come from destroying vegetation, mainly through deforestation (trees soak up the gases when alive, but release it when they are cut down or burned).

Today, the industrialized nations are the largest contributors of carbon dioxide emissions. Over the next 15 years, however, analysts believe that developing countries will contribute about 75% of the increase as they become more industrialized and use their reserves of coal to power their industrialization. Emissions would have to be reduced by 50-80% to maintain CO_2 concentrations at present day levels.

Methane (CH_4)

Sometimes called swamp gas, methane is released into the atmosphere in many ways. Natural gas, which is found underground near petroleum is 96% methane. Methane is produced through anaerobic (without oxygen) processes and is a common byproduct of rice cultivation, the burning of vegetation and the rearing of cattle (these animals belch and pass gas, releasing methane into the atmosphere). With the increasing consumption of beef worldwide, cows are a major source of methane. Methane accounts for 13% of greenhouse gas emissions in Canada. Other sources are wetlands, coal mining, extracting fossil fuels, and decaying garbage in landfills.

Present levels of methane are over 100% higher than pre-industrial levels and atmospheric levels are growing two times as fast as carbon dioxide. Methane is the most potent greenhouse gas worldwide.

Nitrous Oxide (N_2O)

N_2O naturally comes from soils and oceans. The primary human source of nitrous oxide is the use of modern farming techniques which rely heavily on nitrogen-based fertilizers. Deforestation and fossil fuel combustion are other contributors to atmospheric levels of N_2O. Nitrous oxide has also increased in the atmosphere from car exhaust fumes. N_2O is 250 times better at trapping heat than CO_2, but compared to CO_2 there is a much smaller level of N_2O in the air. Nitrous oxide accounts for 5% of greenhouse emissions in Canada.

Chlorofluorocarbons (CFCs)

Normally associated with ozone destruction, CFCs are also very efficient insulators in the atmosphere. CFCs are used in manufacturing foam. They are also used in refrigerators, air conditioners, industrial solvents, car dashboards, couch cushions and other products. Over recent years, CFC production has slowed down considerably as a result of the Montreal Protocol - an international agreement to phase-out CFC production. Major chemical companies are now replacing CFCs with hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) which

are also powerful greenhouse gases. For instance, over a 100-year period, one molecule of HCFC-22 is 1,700 times more powerful at trapping heat than one molecule of CO_2, and HFC-23 is 12,100 times more powerful than CO_2. The use of these compounds has become more common place; in turn, emissions are increasing at a startling rate.

Secondary Greenhouse Gases

Water Vapour (H_2O)

Water vapour is also a greenhouse gas,since moisture traps heat. As the temperature increases, more water evaporates from the ground increasing the amount of water vapour in the air, thereby retaining heat and increasing the amount of humidity.

Ozone (O_3)

Ozone is formed in the lower atmosphere from a chemical reaction involving nitrogen oxides, hydrocarbons and other atmospheric pollutants in the presence of sunlight.

Ground-level ozone also behaves as a greenhouse gas. Since it is a local pollutant, scientists are unable to ascertain how much it actually contributes to climate change. We do know that it creates major health problems for human beings.

Predicted effects of Climate Change on Canada and the World

At a simple level, increased levels of greenhouse gases in the atmosphere should lead to warmer average temperatures on Earth. The exact effects of climate change are uncertain, since it is complicated by several other factors which can influence short term and long term climates.

It is known that climatic instability caused by rapid temperature change could increase the severity and frequency of extreme weather events including storms,droughts and heat waves. The greatest changes are expected to occur in northern latitudes. In turn, Environment Canada predicts that Canada will be one of the most seriously affected areas in the world. For example, Canada could experience winter temperature increases of up to 10°C. There could no longer be a snow season in Southern Ontario.

Changes in temperature are expected to be accompanied by shifts in global rain and wind patterns,affecting Canadian agriculture and water resources. As climatic regions begin to change, precipitation will fall at different times and in different places, severely disrupting food production. Rainfall patterns are predicted to move northward, creating drier conditions in the south. For instance, the 'Wheat Belt' of the prairies may become an inhospitable desert. Another result of drier conditions in the south is that the levels of the Great Lakes may fall.

Thermal expansion of oceans as well as melting of ice caps may raise the ocean levels by one to three meters causing flooding in coastal areas including British Columbia and Atlantic Canada. Furthermore, pests and insects normally found in the south may move northward due to warmer conditions and longer breeding seasons, increasing the rate of disease among humans, animals and vegetation. Melting of the ice caps would make polar waters more navigable, but it would also destroy habitat for arctic animals such as seals, walruses and polar bears. Food supplies for the Inuit people who hunt these animals would be destroyed, and their coastal villages could be wiped out. These are just a few of the hundreds of environmental impacts associated with faster rates of climate change.

Suggested Solutions To Climate Change

Toronto and other cities around the world have committed themselves to reducing CO_2 emissions by 20 % of 1988 levels by the year 2005. When the financial costs of a Canada-wide undertaking were assessed by different provincial energy ministries, they realized that a national 20 % reduction in carbon emissions would save $80 billion dollars by the year 2005! Efforts are now being directed

at improved energy efficiency and energy conservation. On the other hand, meeting the 20 % reduction target is seen as a challenge, although United Nations scientists predict that a 60 % reduction is needed to stop the climate change.

National actions that can reduce greenhouse gas emissions are:

- complete CFC elimination by the year 2000;
- stop the destruction of tropical forests and promote reforestation;
- expand energy conservation efforts;
- further develop renewable sources of energy;
- encourage the use of alternative transportation such as public transit, bicycles, walking,etc.

On another level, we need to redesign the infrastructure used to build our cities over the last 200 years and revise our wasteful habits in order to become more sustainable. For example, many cities were designed around the use of the private car - a very inefficient form of transportation, and many buildings were constructed before energy efficiency was considered important. Redesigning and refitting our existing infrastructure, especially in the industrialized world is an enormous but important task. The most critical step for the developed world is to change the public's attitude regarding their westernized lifestyles. For example, more people have to be made aware of the consequences that result from their use of air conditioners, which contribute to climate change through energy use and CFCs.

We need to act now to *avoid* disaster, rather than waiting to *adapt* to the problem. Furthermore, these measures require the utmost degree of cooperation to reduce global greenhouse gas emissions. The world will have to cooperate to both reduce pollution in developed countries and to assist the developing world avoid relying heavily on fossil fuels.

This kit enables educators to play their part in stopping climate change in a very important way. Teaching children about climate change is not an attempt to change their habits, which is extremely difficult, but to help form their attitudes. Furthermore, we can help to empower children with the proper knowledge to take action against this environmental threat. If we raise our children to avoid wasteful habits, to reduce energy consumption in their daily lives, and get them thinking about more sustainable ways to plan our cities, then we are ensuring that the next generation and each one after that will not make the same mistakes as ours.

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Energy Educators of Ontario. "Global Energy Issues - Teacher's Guide",1992.

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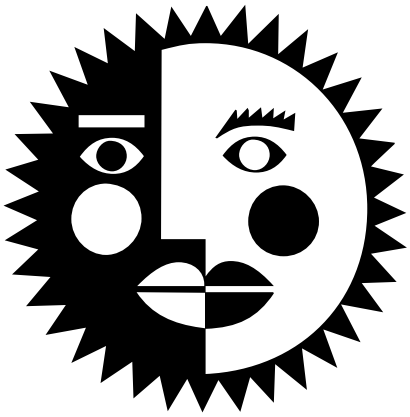
S.A.V.E. Student Action Guide.

PART TWO



Chapter One Overview: **Climate Change**

Lesson 1 **Spaceship Earth**

- An analogy of a spaceship is used to describe the Earth as a system.
- Students estimate how long this spaceship has to exist as a lead in to discuss world problems,specifically climate change.

Lesson 2 **Life Support System**

- The concept of a system is explored with the students physically forming an interconnected circle.

Lesson 3 **The Greenhouse Effect**

- Students set up a five-day experiment to simulate a greenhouse.
- Students work on a diagram to understand the Earth's atmospheric greenhouse effect and why it is working too well.

Lesson 4 **More Greenhouse Experiments**

- Students conduct a modified greenhouse experiment in groups.
- Students learn to manipulate experimental equipment.
- Through a class experiment, students learn how gases travel.

Lesson 5 **Greenhouse Gases**

- Students read about the different greenhouse gases and identify which greenhouse gases are used as a result of daily lifestyle choices.

Lesson 6 **Impacts of Climate Change: A Look at Canada**

- Students learn about the different impacts that climate change will have on Canada through map work and artistic representation.

Chapter One provides students with the basic information that the unit builds upon.The information is constantly revisited in the sections that follow.

Chapter Outcomes: The student will:

1. understand the concept of a system;
2. brainstorm their own examples of a system;
3. appreciate what happens when a balanced system is disrupted;
4. explain how a greenhouse works;
5. explain how the Earth's atmosphere acts like a greenhouse;
6. list and define the greenhouse gases;
7. locate nine potential climate change impacts on a map of Canada;
8. draw six potential climate change impacts for Canada.

Spaceship Earth

Lesson One (optional activity)[1]

Summary: Students listen to the story 'Spaceship Earth', and discuss global and local problems.Students design their own spaceship earth as the title page for this unit.

Length: 45 minutes.

Outcomes: The student will:
1. estimate the time that the Earth can exist with current problems;
2. list 5 world problems;
3. list 5 local problems;
4. become acquainted with the issue of climate change.

Background: Often students do not consider the earth and its problems as a system. This lesson is an approach to introducing the earth as a system, and the fragility of that system when faced with difficult problems, like population explosion, pollution, differences between the developing and the developed world, etc.

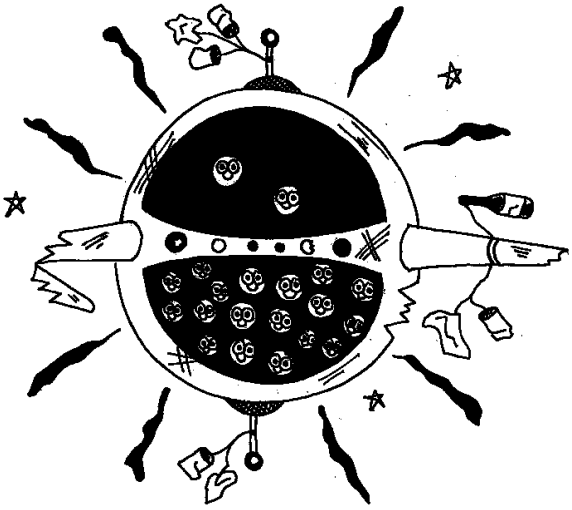
In this lesson, read the story to the students which depicts all of these world problems using the analogy of a spaceship. After you read the story, the students are told that this scenario represents the Earth. Students discuss different world problems. At this point, you can introduce the problem of climate change. Before the lesson, decide whether or not your class needs their own copy of the story.

Materials: Black board and chalk, or primary chart paper and markers.

[1]**Note:** *This idea is not new, but if you have not used it, it can be very effective.*

Procedure:
1. Begin by drawing a simple picture on the blackboard to illustrate the scenario you are about to describe.
2. Start telling the story without mentioning that this situation represents the Earth:

"There is a large spaceship floating permanently in space. The spaceship is divided in half. One half (Side A) contains 10% of the people on board, but they have 90% of all the food and supplies, including electricity. This means that the temperature on this half of the spaceship is always perfect because it can be adjusted by extra heating or air conditioning. The other half (Side B) of the ship has 90% of the people on board and only 10% of the food and supplies. This half of the spaceship is very, very hot, but there is no air conditioning because there is not enough energy to supply it.



Although these two halves of the spaceship seem to work separately, they are actually two parts of one spaceship, and if something goes wrong on one side, the other side will also be affected.

The two sides share a computer which is located at the centre of the spaceship. If it is used properly, it could take charge of this very unequal situation and help to make life on the spaceship better for everyone. But of all the people who use the computer, no one is taking responsibility to solve the problems that exist on the spaceship. Instead, chemicals, oxygen and life support are controlled by anyone who wants to play at the computer. Both sides are very dirty, smoky and polluted. No one is in charge.

Also, both sides of the spaceship have guns and bombs in case a war breaks out between the two sides.

The half with 90% of the people is in dire straights. Even though there are already so many people, many families are having more babies, so there is even less food and fewer supplies to go round. The more crowded it gets, the hotter this side of the spaceship becomes. Most of the people on this half of the spaceship have heard about the 10% on the other side. This knowledge makes them want to either move to the other half of the spaceship, or to increase their amount of food and supplies so that they can live a more comfortable lifestyle like those on the side A. The majority of the 90% cannot afford to move to the other side of the spaceship because you have to pay a lot more to live there. Around 30% of the people on side B have begun to take certain steps to improve their standard of living and raise their level of supplies (like food, clean water, TVs, video cameras, computers and vehicles to move around the spaceship). But as we already explained at the beginning, there is a finite amount of food and other supplies aboard the spaceship. Plus, all the extra production creates a lot of pollution which traps the heat in the spaceship and makes the air a lot hotter. There is a very real threat that as side B becomes more and more like side A, the whole spaceship might overheat and blow up!!

Students, how much longer do you think the spaceship can exist under these conditions? Does it resemble any real-life model that you know of?"

3. It is likely that the students will be shocked to realize that this is the earth. They will be amazed when you tell them that they just predicted the earth has days or hours to exist.

Discussion:

1. Students discuss scenario:

   Explain to students that our earth is just like a spaceship. It is a system that relies on a natural balance of all life forms to exist. This balance is very delicate, so that if there is too much of one thing or too little of something else, all living forms (humans, animals and plants) will suffer. In the natural world, everything is held in check by an internal regulator (many people know it as Mother Nature). When humans attempt to change and alter nature for their own good, the internal regulator becomes powerless and problems arise.
2. Ask students to list 5 world problems. Write them on the board.
3. Ask students to list 5 local problems. Write them on the board.

Discussion tips

World Problems	***Local Problems***
1. deforestation	1. pollution
2. climate change	2. homeless people
3. pollution	3. hunger
4. hunger	4. garbage
5. disease	5. lack of parks and trees

4. If there is enough time, the teacher can divide the class into small groups (3-5 students). Each group should choose one world or local problem and act it out in a single 'Freeze' position (frozen picture) in front of the class. The rest of the class should be able to guess what problem

the group is portraying. Discuss the problem after each scenario. If there is no time to do the 'Freeze'activity, choose a few world and local problems to discuss as a class.

Closure: To wrap up the lesson, introduce climate change (global warming) to students as the central issue of this upcoming unit. Explain to students that they will be learning about climate change, but more specifically they are going to learn about what they can do to help stop this warming trend.

Extension: Students can draw their own Spaceship Earth to use as their title page for this unit. Otherwise, as a more comprehensive art activity, students can create their own visual representation of the Spaceship through clay, painting, plasticine, etc. They can also try to design it on the computer.

Consider reading to the class Canadian author, Monica Hughes' *Crystal Drop* as a complementary language component to the unit. The novel is set in the future and tells the story about a group of childrens' adventures in the face of ozone depletion and global warming.

Source:

Adapted from Mark A. Williams, Kennedy Middle School, Albuquerque, NM.

Send home the **Letter to Parent/Guardian** found at the beginning of the APPENDIX which informs parents about this unit.

Life Support System

Lesson Two

Summary: In this activity, students physically form an interconnected circle to understand delicate balance of a system.

Length: 45 minutes.

Outcomes: The student will:

1. explain the term - balanced system;
2. understand that humans and plants are part of a balanced system;
3. appreciate that disrupting a natural balance can destroy a system.

Background: In order for students to understand the greenhouse effect, they must understand what is meant by a system. Ecology education is all about systems in nature and their interrelationships. In the next lesson, students will learn about the greenhouse effect which has maintained a delicate balance in the atmosphere, making life on Earth possible.

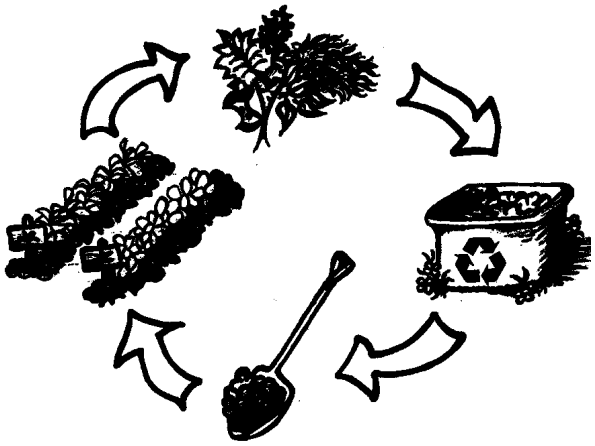
Materials: Open space.

Procedure:

1. Clear an area in the classroom, use the gym or go outside.
2. Number off students 1 to 4. Assign each group an area of the classroom to stand.
3. Assign each group following roles: group one - *plants,* group two - *humans,* group three - *greenhouse gases,* group four - *sun rays.*
4. One student from each group stands in the middle of the room, standing shoulder to shoulder and facing the centre of the circle.
5. Keep adding one member of each group to the circle, until the whole class is in the circle.
6. Ask the students to turn to the RIGHT and take one step into the middle of the circle. Students should be standing behind each other, looking at the back of the student in front of them.
7. *Instruct the class to listen carefully.* Everyone places their hands on the shoulders of the student in front of them. Make sure that the toes of each students' left foot touches the heel of the students' left foot in front of them. On the count of three, students SLOWLY start to bend and sit on the knees of the student standing behind them.
8. Then you say:"Plants, humans, greenhouse gases and sun rays need to work as a system for us to have a sustainable planet." If something is sustainable, it means it will last for a long time.
9. Instruct the students to stand up, but ask the *plant* group to walk away. Still keeping as large a circle as before, ask the students to attempt the 'habitat sit' again. (If students are able to do this, ask the *greenhouse gas* group to leave). After the 'sit' collapses, and the students laughter has died, ask the students to sit down.
10. Review the concept of a system -- ie. interdependent components acting together. In general, the world itself is made up of hundreds of interconnected systems from political systems to natural ecosystems, right down to our very own bodies. Explain that the atmosphere is a system, in which plants, gases,humans and sun rays interact to produce conditions possible for life.

11. Explain that the atmosphere has historically worked as a balanced system because of the natural balance that has existed between sunlight entering and heat escaping the atmosphere. Over the past 200 years (since the industrial revolution),human activity has upset this balanced system by emitting too many heat-trapping gases into the air. The increase of greenhouse gases do not allow enough heat to escape from the atmosphere, and so the Earth is warming up. (Students will gain a better understanding of this natural balance in Lesson 3).
12. Use this activity to spark a group discussion. What other systems do students know of?
    - family unit
    - transportation system
    - digestive system
    - system of government (municipal,provincial, federal)
    - solar system
    - ecosystem (river or forest, etc.)
    - bee hive system

Closure: Ask students to draw a closed system that they know of or one that was just discussed. For example, students could draw the composting system like the one below, with a healthy plant,the plant decomposing and fertilizing the earth, and new flowers growing.



Next class we will look at the atmosphere as a balanced system in detail.

Source:

Adapted from the Habitat Lap Sit lesson in Project Wild.

System:
An ecological, social or economic unit of organization made up of interdependent parts.
- *Common Curriculum, Policies and Outcomes, Grades 1-9, pg. 27.*

The Greenhouse Effect

Lesson Three

Summary: Students discuss how a greenhouse works by looking at the diagram on HANDOUT 3-A. They then set up their greenhouse simulation experiment to be observed over the next few days. Once the experiment set up is completed, the class works through a diagram how the atmosphere acts like a greenhouse using HANDOUT/OVERHEAD series 3-C.

Length: Two 40 minute periods.

Outcomes: The student will:

1. explain how a greenhouse works;
2. simulate a greenhouse (HANDOUT 3-B);
3. work cooperatively in a group activity and manipulate experimental apparatus;
4. understand how the Earth's atmosphere naturally acts like a greenhouse using a diagram;
5. graphically demonstrate how the natural greenhouse effect is no longer working well because of a thicker greenhouse gas layer in the atmosphere.

Background: By now, the teacher should have read through the Background Material on Climate Change. It is important that teachers read through this article to get a better understanding of how the greenhouse effect works and the human and environmental impacts of climate change.

The overheads in HANDOUT 3-C consists of three pages and it is also used in Lesson 5.Copy the three pages onto acetate. Tape the left edge of the acetates together so that they are properly lined up when you flip one over the other.

Background for Experiments: For the next two experiments (Lesson 3-B and Lesson 4),the class should be divided into groups of four so that each student can adopt specific roles. Initially, you may want to assign the roles, but instruct students that they can rotate roles for the next experiment. Consider making cards for each role so students understand their responsibilities clearly:

Experimenter : Manipulates materials and states observations.

Recorder : Records group results on the recording sheet.

Timer : Helps group manage time effectively (Lesson 4).

Materials Manager : Keeps group on task,gets material for the group and ensures that it is all returned.

Having students assume different roles requires a degree of cooperative learning. Students need to understand the four different roles well. For example, explain each role to the students and have them explain it back to you. You may find some resistance at first to this method of learning. As the students become more comfortable cooperating and depending on each other, the activity should run more smoothly. You may want to practice on a non-academic task first.

Materials: HANDOUT 3-A; HANDOUT 3-B (see experimental materials); **HANDOUT/ OVERHEAD ser ies 3-C :** Teacher's Edition, Student Copy, Overhead (3 pages).

Procedure:

1. Display HANDOUT 3-A of the greenhouse on an overhead, and give each student their own copy.
2. Ask students to explain how a greenhouse works in their own words. What does it feel like to be inside a greenhouse? (very warm and humid).
3. Using the diagram, explain that the sun releases most of its heat in the form of light rays:
   - The rays are taken in by the plants and soil inside a greenhouse, and the plants get warm. This raises the temperature inside the greenhouse.
   - The warm soil and plants also give off heat but not like light rays. These new rays of heat cannot pass through the glass, and instead they get trapped inside the greenhouse.
   - With these warmer temperatures inside a greenhouse, plants and vegetables can grow faster and all year round.
4. Ask the students to write down the outcomes of the two sun rays that enter the greenhouse in the spaces provided at the bottom of the handout. Make sure that students understand that sunlight is absorbed by dark surfaces (soil and plants) and reflected by light surfaces (glass or water). The answers to the HANDOUT are as follows:
   1. Light rays are absorbed by the plants making them warm so they can grow.
   2. The plants and soil release some of their heat.
   3. The heat gets trapped by the glass roof of the greenhouse and the temperature is raised.
5. Moving on to the greenhouse simulation experiment on HANDOUT 3-B, divide students into groups of four.
6. Explain the different roles to be performed. You may wish to distribute cards with job names on them. Hand out a copy of HANDOUT 3-B to each student.
7. In this lesson, students set up the experiment and hypothesize the results. The results will be recorded on the fifth day.
8. Once the set up is completed, tell the groups to write down their hypotheses on their handout in the space provided.
9. Regroup the class and briefly discuss their hypotheses.
10. Now say to students: "The world has its own greenhouse made of gases, what is it called? (atmosphere).The atmosphere has an insulating effect - it lets light in and holds heat."
11. Display page one of OVERHEAD 3-C (How the Greenhouse Effect Works) on the projector. Point out the sun, the earth, and the atmosphere.
12. Say:"This is how the Earth's atmosphere acts like a greenhouse. Light rays from the sun radiate down to the earth. Lay page two of the acetate over page one. Describe the outcomes of the five light rays. The explanation of outcomes can be found on the Teacher's Edition of HANDOUT 3-C.
13. Explain to students that the greenhouse layer only makes up one percent of the atmosphere. That size is comparable to the skin layer that covers an apple. Let them know that there are now more greenhouse gases in the atmosphere than ever before, so that outcome #1 (greenhouse gases trap radiation) is occurring at an increased rate.
14. Have students draw the five incoming rays onto their handouts and write down the outcomes. Say:"Next lesson we will look at the gases that increase the greenhouse effect".

Closure: Review the system concept - historically the atmosphere has been a balanced system between light coming in, heat being trapped, and heat escaping to space. Today's average world temperature is 15°C with the help of the greenhouse effect. Without this system, the Earth would be 33°C colder at -18°C. If we upset the system too much, we will tip it to the other side of the scale making the Earth too hot for life to exist.

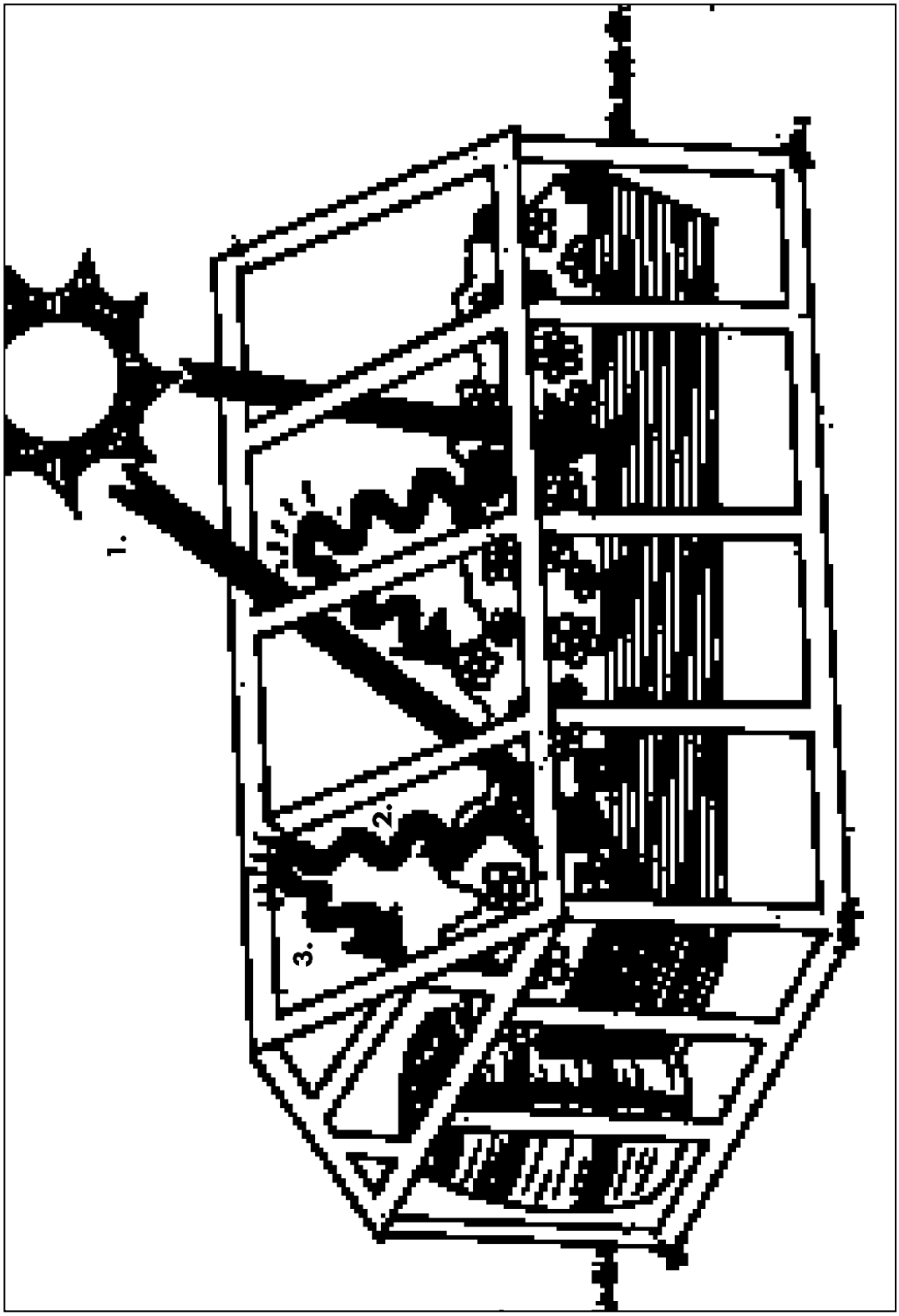
Extension: Tell students to clip news articles on climate change and/or global warming. Create a bulletin board to post them on.

Answers to Discussion in the Greenhouse Simulation Experiment:

1. Students should observe better sprout growth in the plastic bag, i.e. there should be more sprouts and they should be taller than those in the control pot. The soil in the plastic bag should still be moist, and it should feel warm inside when students open the bag. The soil in the control pot should be drier.

2. The plastic bag acts like the glass windows of a greenhouse and traps heat and moisture, which is similar to the way carbon dioxide and other greenhouse gases trap heat inside the atmosphere.

How A Greenhouse Works



Describe what happens to the sun's rays in three steps:

1. _____

2. _____

3. _____

Greenhouse Simulation Experiment

Group members: _____

Recorder name: _____ **Date:** _____

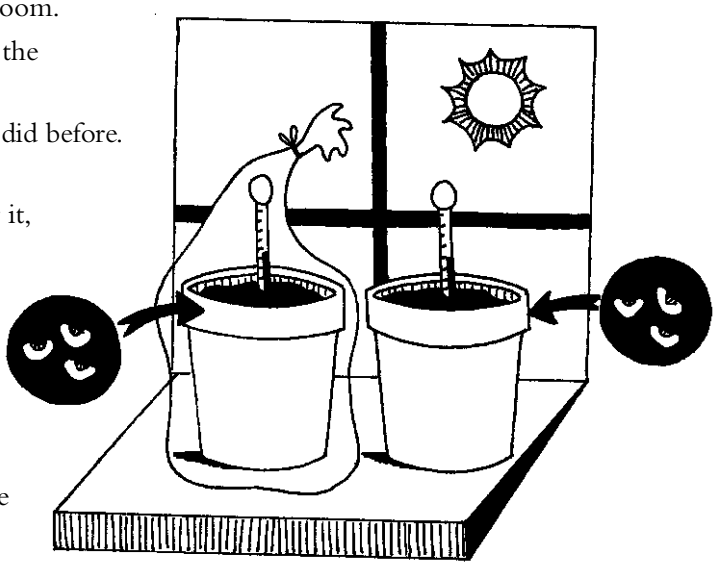
Purpose: To simulate the functioning of a greenhouse.

Materials:
- some water
- some soil
- two small flower pots (you can use small glass jars)
- alfalfa seeds or beans (alfalfa seeds sprout faster)
- a large clear plastic bag and a twist-tie
- two small outdoor thermometers

Note: *If you're using beans, remember to soak them overnight.*

Method:

1. Fill one of the pots with soil and sprinkle alfalfa seeds over the surface or push 3 or 4 beans about 2.5 cm into the soil.
2. Water the soil well.
3. Gently stick the bottom end of a thermometer into the soil so that it is standing upright.
4. Put the whole pot in a plastic bag and close it with the twist-tie, making sure it's airtight.
5. Place the bag on a sunny window sill in the classroom.
6. Fill the second pot with soil, sow some seeds over the surface or plant beans as before, and water it well.
7. Place the second thermometer into the pot as you did before. (If it won't stay up, stand it beside the pot).
8. Place the second pot, with no plastic bag to cover it, beside your little greenhouse.
9. Don't water either pot over the next few days.
10. Write down your hypothesis for this experiment on the space provided below.
11. After waiting five days, open the plastic bag and carefully observe the contents of the pot. Write down the differences between the two pots on the table below and answer the discussion questions.



Hypothesis: What do you think will happen over the next five days and why?

_____

_____

_____

Observations: Fill in the table after five days.

Observation Table	***Greenhouse***	***Control Pot***
1. Number of sprouts		
2. Moisture (are there any water droplets on the bag?)		
3. Temperature		
4. Height of sprouts		

Discussion: What were the differences between the two pots?

_____

_____

_____

How is this experiment similar to the bigger greenhouses and the greenhouse effect that we learned about?

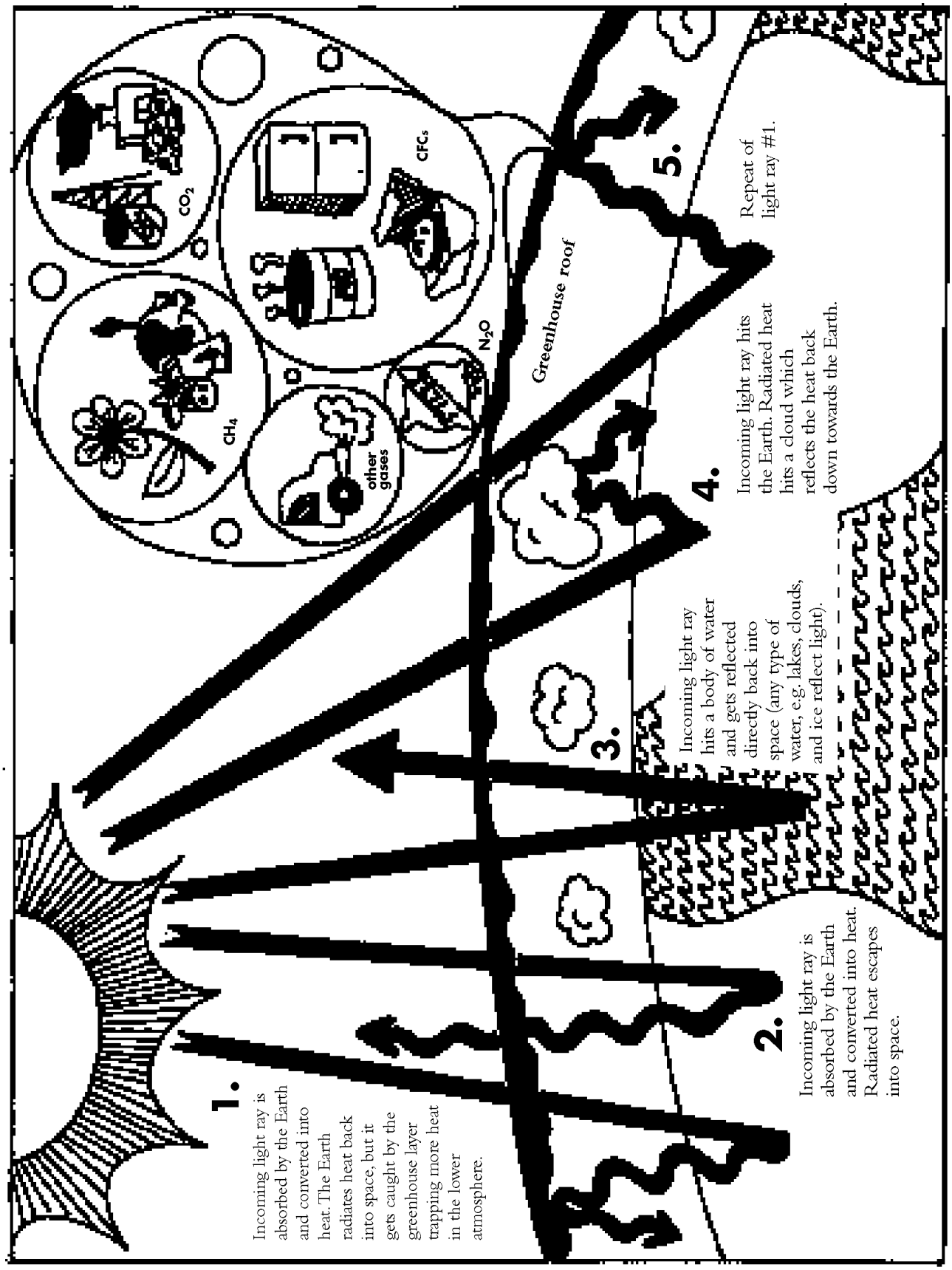
_____

_____

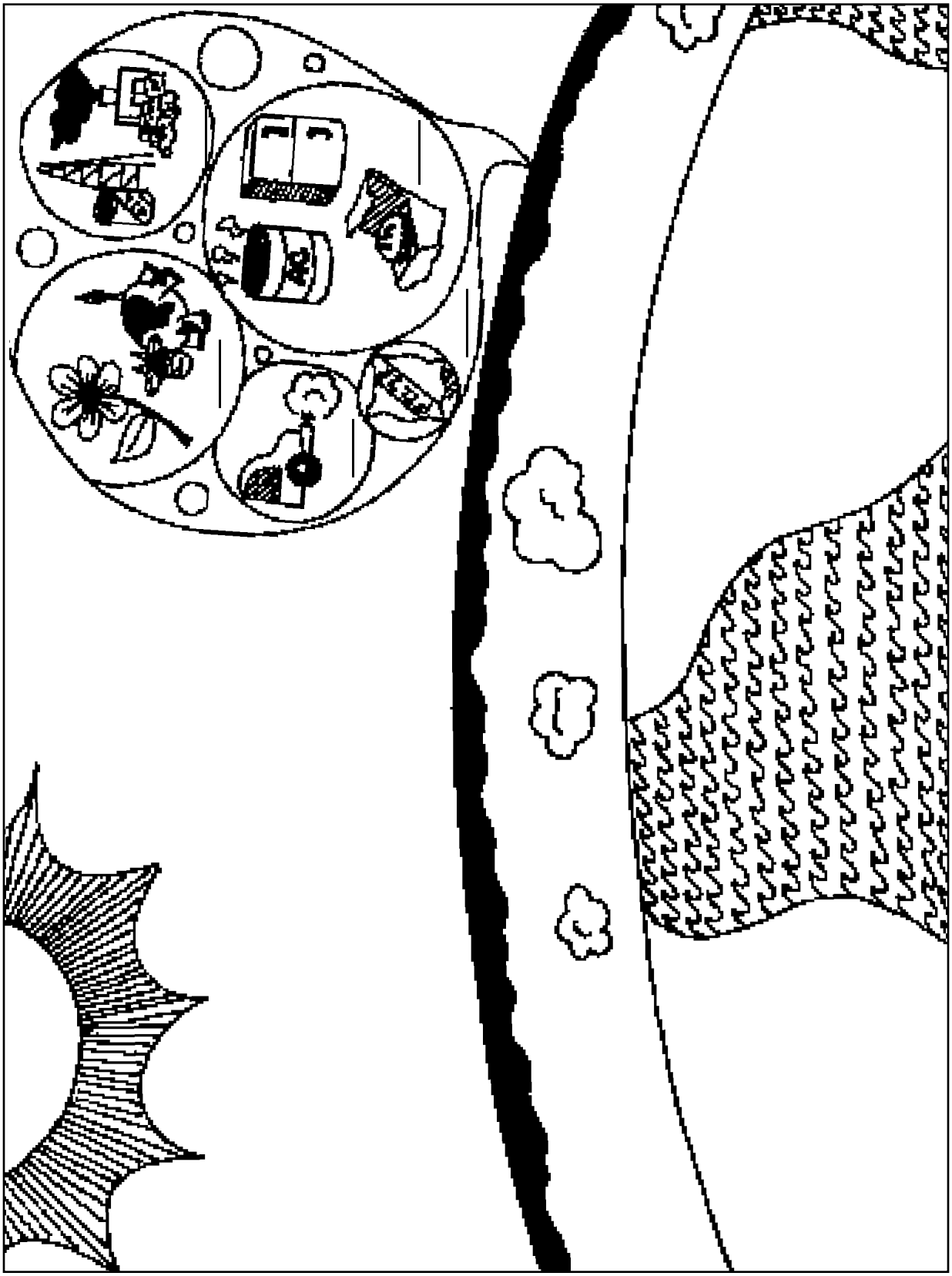
_____

_____

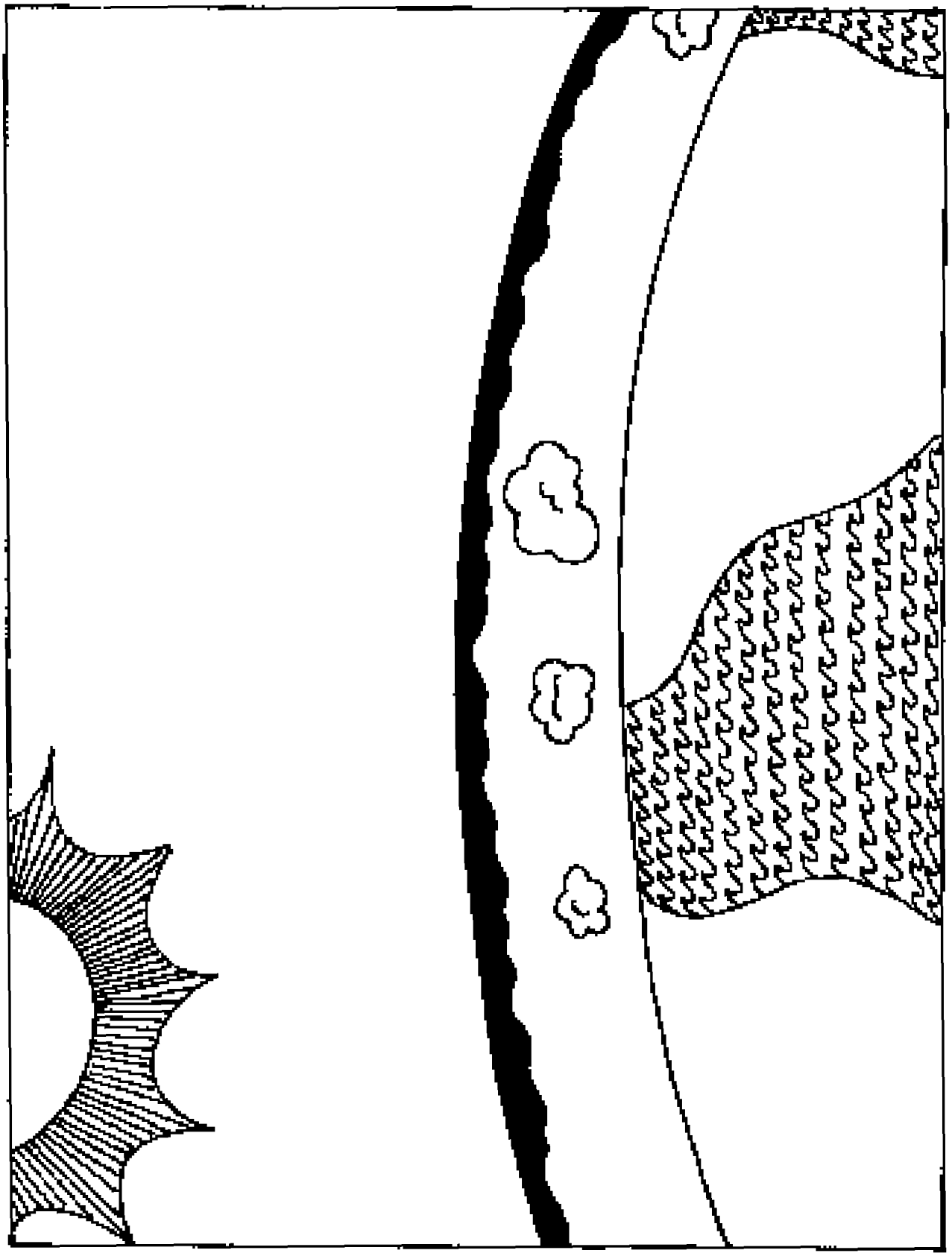
How the Greenhouse Effect Works



How the Greenhouse Effect Works



How the Greenhouse Effect Works



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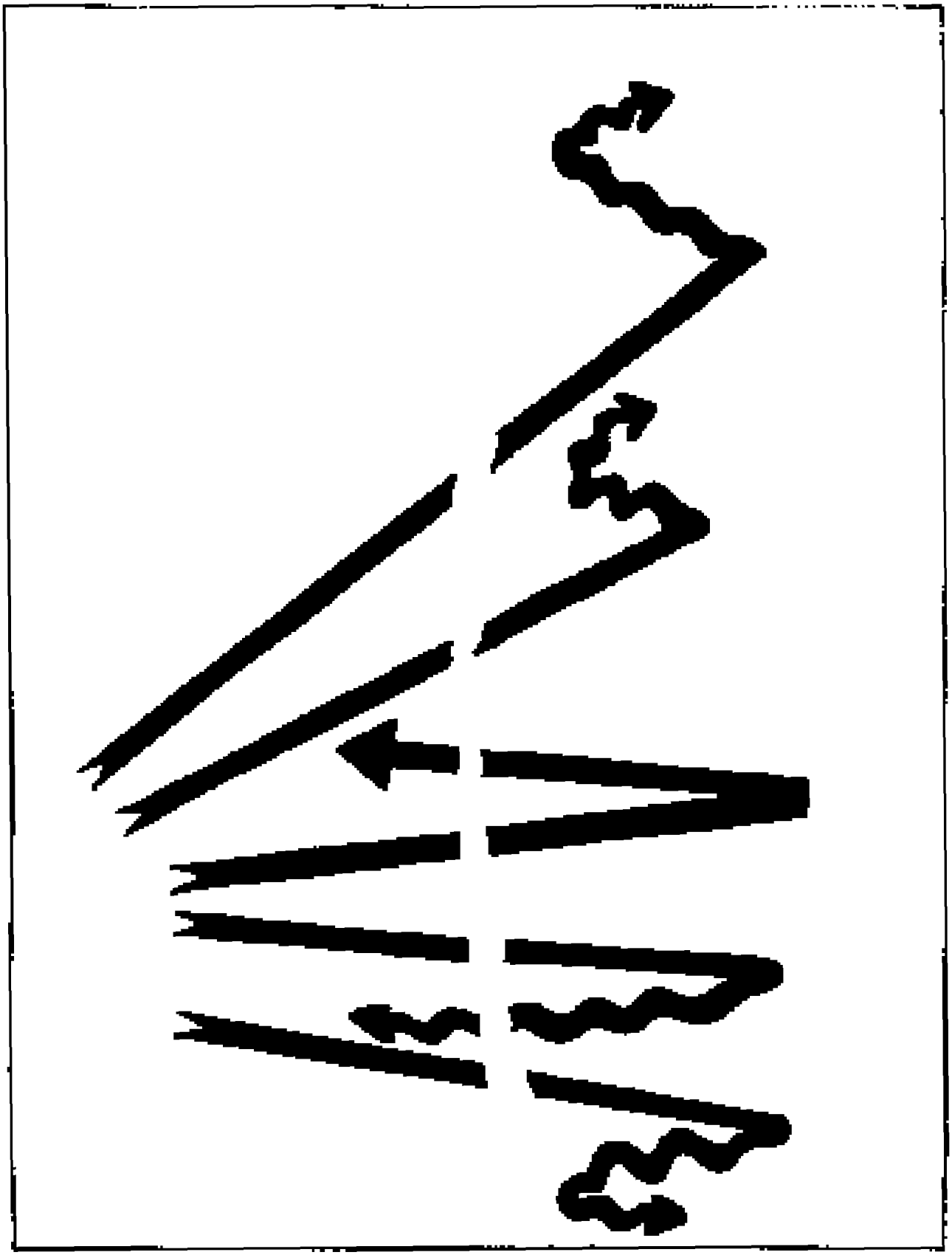
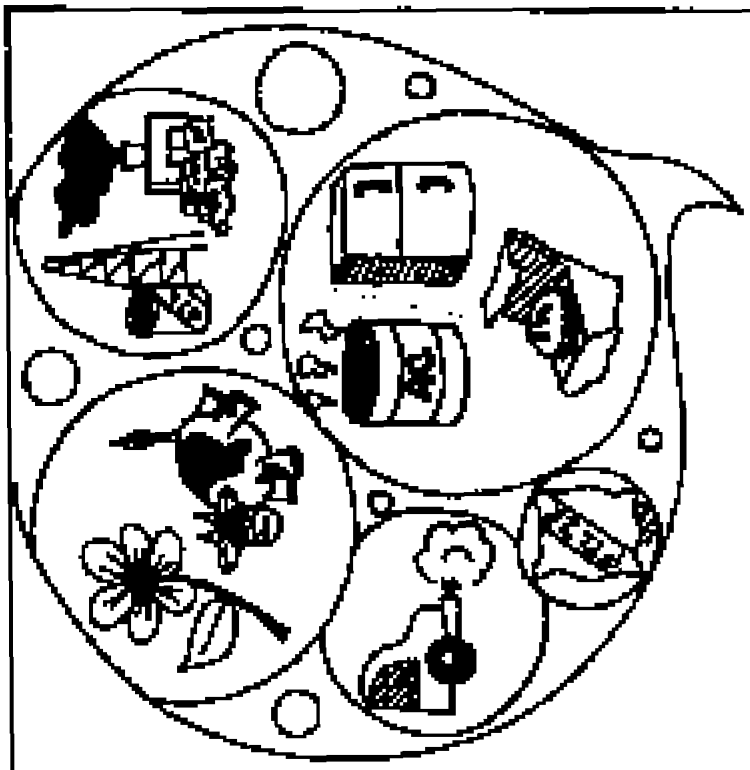


How the Greenhouse Effect Works



More Greenhouse Experiments

Lesson Four

Summary: Students conduct two experiments - on the greenhouse effect and diffusion. The first one can be performed in groups,and the second requires the entire class. Rotate students' roles assigned in Lesson 3.

Length: 45 minutes.

Outcomes: The student will:

1. conduct an experiment to see how colour influences the rate of sunlight absorption on different surfaces (HANDOUT 4-A);
2. work cooperatively in a group activity and manipulate experimental apparatus;
3. participate in a class demonstration to show how gases travel according to the concept of diffusion (TEACHER'S HANDOUT 4-B).

Background: This lesson adds on to those concepts learned in Lesson Three. Students modify the greenhouse simulation experiment to show how different surfaces absorb sunlight at different rates. An experiment on diffusion is used to demonstrate how gases travel around the atmosphere.

Materials: See the materials section for the experiments in HANDOUT 4-A & 4-B, (photocopy Experiment 4-A for students).

Procedure:

1. Review with students what they learned last class, i.e. how a greenhouse works and how the greenhouse effect works. Inform students that today they will perform two more experiments to help them better understand the greenhouse effect.
2. Divide students into their groups from last class, and handout a copy of HANDOUT 4-A to each student.
3. Have the groups rotate their roles by passing their cards to the student on their right.
4. All groups set up their experiment and place them on the window ledge.
5. Begin timing.The recorder is responsible for checking the jar every five minutes to take temperature readings. Write the times on the board that the recorders are to return to the experiment to check the temperature.
6. The other students can copy the readings onto their own sheets.
7. When the results have been recorded, ask students to clean up their experiments. Have a table at the back of the classroom for students to return their equipment.
8. Give the students some time to answer the questions on their handout. Answers can be found at the end of this lesson.
9. Perform the second experiment while students are seated at their desks. As a class, take up the questions on the bottom of the experiment sheet.
10. If there is remaining time, let students finish writing their answers on HANDOUT 4-A. If no time is remaining, assign it as homework.

Closure: Ask the question:who gets hotter on a sunny day - someone wearing a black t-shirt or someone wearing a white t-shirt, and why?

- A person wearing a black t-shirt will be hotter on a sunny day because black absorbs light and turns it into heat. The white t-shirt will reflect some of the light, and the person wearing it will not be as hot. When talking about the Earth, the black t-shirt is like the land, and the white t-shirt is like lakes and other water bodies.

or

Ask the class if anyone has seen the movie with Kevin Costner called "Waterworld." Ask those students to tell the others what happened in the movie due to global warming.

- The glaciers melted, ocean levels rose and flooded the earth's surface. As a result,the remaining humans had to live on water on large ships and floating villages. (Note:The movie is not scientifically accurate, e.g. the whole earth will not be submerged under water even in a worst-case scenario, but the movie does illustrate some of the possible effects).

Answers to Discussion in Greenhouse Effect Simulation Experiment (HANDOUT 4-A):

1. The temperature should rise higher and faster in the jar with black paper. The temperature in the jar with tin foil should increase less and slower.

2. The glass jar acts like the glass windows of a greenhouse by trapping heat,which is also similar to the way carbon dioxide and other greenhouse gases trap heat in the atmosphere.

3. **a)** Black paper = land,pavement, or any dark surface.

Tin foil = water bodies like lakes, oceans, glaciers, etc.

b) Dark surfaces absorb heat and light surfaces reflect it.

Greenhouse Effect Simulation Experiment

Group members: _____

Recorder name: _____ **Date:** _____

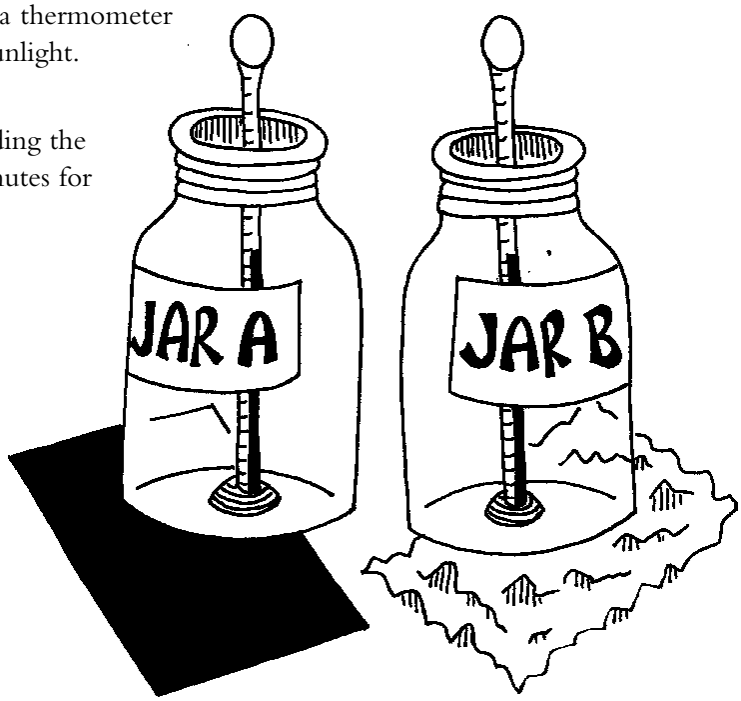
Purpose: To simulate how different surfaces on the Earth absorb sunlight at different rates.

Materials:
- 2 glass jars (e.g. pickle jars)
- modelling clay (optional)
- black paper
- tin foil
- 2 outdoor thermometers small enough to stand upright in the jar
- table or ledge in full sunlight

Note: *If there is not enough sun, consider using small lamps instead (two per group).*

Method:

1. In one jar, place a roll of black paper. Place a thermometer in the jar, so the thermometer is exposed to sunlight.
2. In the second jar, place a roll of tin foil. Place a thermometer in the jar, so the thermometer is exposed to sunlight.
3. Make sure both jars are in full sunlight.
4. Take readings of both thermometers by recording the temperature of each thermometer every 5 minutes for 20 minutes.



Hypothesis: Before you begin, what do you think will happen over the next twenty minutes, and why?

_____

_____

Observations:

Time (min)	*Jar with Black paper Temperature (in C)*	*Jar with Foil paper Temperature (in C)*
0		
5		
10		
15		
20		
25		
30		

Discussion:

1. What happened in the two Jars, was there a difference and why?

_____

_____

2. What role does the glass play in this experiment, and what does it resemble?

_____

_____

3. What type of surfaces does the black paper represent and what does the tin foil represent? What is the difference between the two?

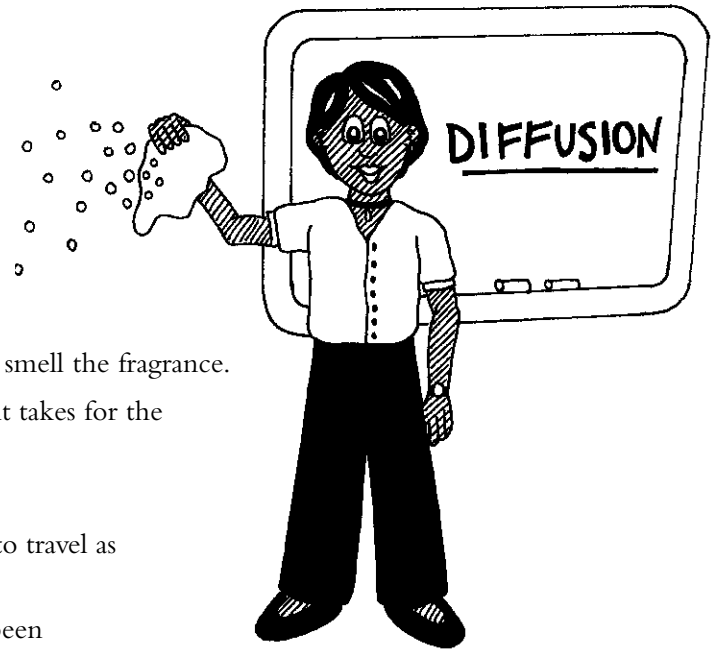
Black paper: _____

Tin foil: _____

Gases Can Travel – Class Experiment

Purpose: To show how greenhouse gases get into the atmosphere through the process of diffusion.

Materials:
- vanilla extract
- perfume or cologne
- two small pieces of cloth



Method:

1. Standing at the front of the class, the teacher puts some perfume on a piece of cloth.
2. The teacher holds the cloth up and waves it slightly in the air.
3. Students raise their hands as soon as they can smell the fragrance.
4. Students are instructed to observe how long it takes for the whole class to smell the fragrance.
5. Repeat the procedure using vanilla extract.
6. Compare how long it takes the vanilla smell to travel as compared to the perfume.
7. Discuss diffusion according to what has just been observed, and try to define it. **The proper definition is:** *When an odour or gas particles move from a place of higher concentration to a place with a lower concentration.*

Discussion Question:

Why do greenhouse gases diffuse up into the atmosphere instead of staying low to the ground?

- The gases travel upward because there is a lower concentration of greenhouse gases in the upper atmosphere.

Experiment 1.3 Illustrates:

- tiny particles that make up a gas (molecules) travel from where there are many of them (high concentration) to where there are few of them (low concentration)
- the size of the molecules affect the rate at which gases diffuse

Koral,A.,"Gases Can Travel"in *Our Global Greenhouse*, pg. 57.

Greenhouse Gases

Lesson Five

Summary: In the first part of this lesson, students learn about greenhouse gases by reading information and applying it to their own lives, matching written information with pictures of greenhouse gas sources,and through a discussion with the teacher (30 min).In the second part, the class moves to the teacher's parking lot and performs an experiment on a car (15 min).

Length: 45 minutes.

Outcomes: The student will:

1. process information regarding greenhouse gases contributing to global warming;
2. understand that their daily actions produce greenhouse gases;
3. hypothesize what comes out of a car exhaust pipe and observe the results;
4. understand that human activity is accelerating the greenhouse effect through an unnatural build-up of greenhouse gases.

Background: This lesson is divided into two parts. Part I consists of classroom activities and group discussion where students make the connections between greenhouse gases and their own lives. It is important that students realize most of these gases exist naturally in the air, but as a result of coal burning,automobiles, deforestation, agriculture, and coolants, these gases are now present in massive amounts.

Part II is a hands-on car test that the teacher conducts with the class. The test consists of tying a coffee filter or handkerchief to the end of an exhaust pipe to prove that carbon dioxide and other gases are emitted from cars. This live exercise will help to impress the connections in students' minds between their actions and greenhouse gases. Since you will be outside, it might be a good idea to plan this lesson before a recess or lunch break. Don't forget to see if it's necessary to get permission from your principal before trying this activity, and do not use any plastic or anything that is flammable.

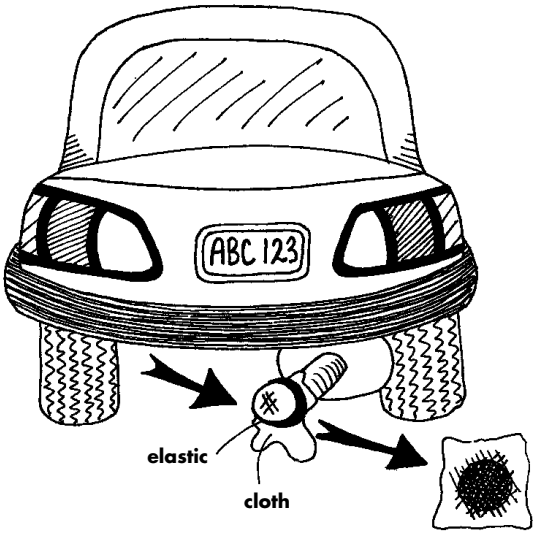
Materials:
Classroom: HANDOUT 3-C, OVERHEAD 3-C (three pages) from Lesson 3, HANDOUT 5-A, overhead projector. **Teacher's parking lot:** Car, coffee filter or handkerchief, elastic band.

Procedure:

1. Review the question from last class:someone wearing a black t-shirt becomes hotter on sunny days because black absorbs light and turns it into heat. Someone wearing a white t-shirt will reflect some of the light, feeling cooler than the person with a black t-shirt. When talking about the Earth,the black t-shirt is like land, and the white t-shirt is like the clouds and other water bodies.
2. Tell students that today we are going to learn what gases make up the greenhouse roof in our atmosphere. Ask if anyone can guess what these gases are or where they come from. Don't tell them yet if they are right or wrong.
3. Ask students to take out their handout of the greenhouse effect (HANDOUT 3-C). Distribute HANDOUT 5-A which lists the different greenhouse gases and their sources.
4. At this point you may want to break up the class into small groups. Tell students that for this

activity they are to read to the top half of HANDOUT 5-A and answer the questions on the bottom. When they are finished,they can match the right greenhouse gas with the pictures in the top right hand corner on HANDOUT 3-C. Answers to HANDOUT 5-A can be found at the end of this lesson.

5. When most of the class is finished, take it up together. You may want to show OVERHEAD 3-C at the front of the class. Clockwise starting from the cow and flower, the gases are: "methane (or CH_4)", "carbon dioxide (or CO_2)","CFC gases","nitrous oxide (or N_2O), and "other gases". The Teacher's Edition of OVERHEAD 3-C shows the correct place for each gas. (For "other gases", a car is used because cars emit many gases at once).
6. Make sure that students realize that most of these gases occur naturally in normal amounts. For example, carbon dioxide naturally comes from decay of materials, respiration of humans and animals, and natural forest fires. The problem arises when these gases are emitted as a by-product of human activities, because then they occur in unnatural and unhealthy amounts in the atmosphere.
7. Focus in particular on CO_2. Ask students to highlight carbon dioxide on their handouts. Have students write down on HANDOUT 5-A that CO_2 is the largest greenhouse gas by volume. It accounts for between 40-60% of the warming.
8. Tell the students that one of the biggest contributors of CO_2 is the car. To get an idea of how much carbon dioxide is emitted from a car, we are going to go outside and do a test.
9. Tell students to quietly get their coats on and line up at the door (don't forget to turn off the lights in the classroom when you leave!).
10. When everyone is ready, take the students to the teacher's parking lot and have them stand around the car that you will be testing. Before you begin, remind students that what you are about to do is extremely dangerous and they should NEVER try this on their own. Also tell them that it is very important to only do this outside because the gases from the car are very toxic and they can be fatal if you are indoors.
11. Allow a student to place a coffee filter or a handkerchief over the exhaust pipe of the car and secure it with an elastic band. Ask the class what they think will happen to the filter paper after you have let the engine run for a few minutes (hypothesis).



12. Once everyone is standing two feet away from the car, turn the engine on for 3-4 minutes.
13. Remove the filter and examine it with the class. Carbon dioxide is the main gas emitted from car fumes, but there are also nitrous oxides and sulphur dioxides.All three gases are clear gases. The filter will be blackened by the particulates that get emitted with the gases (particulate matter are air-born particles made up of dust and smoke ash). Ask students to think about that fact that if this much 'dirty air' comes out of one exhaust pipe in only 3 minutes, just think how much carbon dioxide and other pollutants enter our air when there are millions of cars on the road 24 hours a day.
14. Tell students that it is possible to see the clear

gaseous fumes on very hot days in the summer, for example while driving on the dark pavement or on a basketball court, or even the air on top of a camp fire. It will seem like you are looking at a hazy-like mirage.

15. This is also a good time to remind students that idling (running your engine while stationed in one spot) is 3-5 times more polluting than simply driving your car, because more gases are released while idling.
16. Either dismiss your class for recess or return to your classroom.

Closure: In the remaining time of your lesson, tells students to put away all their books. See if they can remember the names of the greenhouse gases and where they come from. You can turn this into a 'quiz show' game: divide the class into two teams, ask a question to two students at the same time and whoever gets the answer first receives a point. The team with the most points wins.

Answers to HANDOUT 5-A:

1. methane, carbon dioxide
2. methane, CFCs
3. carbon dioxide, nitrous oxide
4. carbon dioxide
5. CFCs
6. methane, carbon dioxide
7. nitrous oxide, carbon dioxide
8. carbon dioxide, nitrous oxide
9. CFCs
10. carbon dioxide

A Common Myth:

"Global warming and ozone depletion are the same thing"

Although some gases cause both global warming and ozone depletion, these atmospheric phenomena are not the same thing. For instance, ozone-depleting substances,including CFCs and halons, are also heat-trapping greenhouse gases. Yet when CFCs cause ozone depletion in the stratosphere, they cause that area of the stratosphere to cool. The end result of these heating and cooling processes is not yet known, leaving much scientific debate about the overall relationship between ozone depletion and its potential impact on global warming.

A Matter of Degrees: a Primer on Global Warming: Environment Canada.

Greenhouse Gases & Their Sources

Name: _____

Read the information and fill in the correct gas next to each question below.

Methane (CH4)
Methane exists naturally underground and in wetlands, so it got the nickname 'swamp gas'. Methane also comes from many human sources. They include: rice cultivation, burning of vegetation, cattle ranches (after cows eat, they belch and pass methane into the air),coal mining and decaying garbage in landfills.

CFCs
CFCs are released from human-made products. They are not natural. Mainly, CFCs come from manufacturing foam, like foam mattresses and seat cushions. They also act as coolants in refrigerators, and air conditioners. CFCs are released whenever any of these products are broken or thrown away. CFCs used to be in aerosol spray cans, but they have been banned.

Carbon Dioxide (CO_2)
Carbon dioxide is the most damaging greenhouse gas at the moment, since it accounts for over half of the warming. Human sources of carbon dioxide come from burning fossil fuels (coal, oil,petroleum) for heating and electricity, and deforestation (trees soak up carbon dioxide when alive, but release it when cut down or burned). Carbon dioxide is naturally produced from human and animal respiration, but this amount does not impact the greenhouse effect.

Nitrous Oxides (N2O)
Nitrous oxide naturally comes from soils and oceans. Human sources of nitrous oxide come from nitrogen-based fertilizers in agriculture. Nitrous oxide is also released from cars, burning fossil fuels and deforestation.

Which greenhouse gas is used when I do the following? (In some cases, there may be more than one gas).

1. Throw away paper that could be reused or recycled? _____
2. Buy a hamburger in a styrofoam container? _____
3. Ask for a lift to the corner store instead of biking? _____
4. Keep my computer on overnight? _____
5. When my parents throw away our old air conditioner? _____
6. Use disposable plates at a birthday party? _____
7. Eat fruit that has been grown on a large farm in Florida? _____
8. Wait for someone in the car with the engine running? _____
9. Throw away old couch cushions? _____
10. Keep the door open on a cold day? _____

Impacts of Climate Change: A Look at Canada

Lesson Six

Summary: Through map and art work, learn about the different impacts climate change will have in Canada. To synthesize everything they have learned thus far, students write a creative writing story about life in the year 2100.

Length: 45 minutes.

Outcomes: The student will:

1. summarize the greenhouse effect;
2. summarize climate change;
3. appreciate that climate change has huge consequences for humans and nature;
4. write a creative story about life in the year 2100.

Background: Lesson Six is a wrap-up to Chapter One. In this lesson, students synthesize what they have learned about the greenhouse effect. They learn how climate change will impact humans and nature throughout different regions in Canada by studying a map, and graphically representing how these impacts will change Canadian geography.

This is the last lesson students will have on the scientific basis for climate change. In the remaining sections, students will participate in activities that will show them how to slow down this warming trend.

Materials: Primary chart paper, markers,15-20 atlases, HANDOUTS 3-C, 6-A, 6-B.

Procedure:

1. Return to the greenhouse effect diagram (HANDOUT 1.2).
2. Review what the greenhouse effect is (ask students to explain it in a couple of concise statements).
3. Compose with the class, "The Greenhouse effect is ...." and students copy onto handout. Also copy onto primary chart paper and post in the classroom.
4. Read the following quote: "Imagine prairies turning into vast deserts. Picture forests turning into tropical jungles. Think of the North Pole melting and the oceans rising. These are some of the changes that some say could happen with the greenhouse effect -- perhaps by the middle of the 21st century." (Source:The Greenhouse Effect, by Jack Harris).
5. Discuss the quote with the class. Why would this happen if the greenhouse effect is a balanced system? (We have upset the balance).
6. Ask students if they know what is creating the imbalance in this system causing the earth to warm. Return to the "Life support system" activity from Lesson Two. What happens if we change a system quickly? (the system may fall down).
7. Say: "As a result of human pollution, the greenhouse effect is working too well.The addition of human produced gases that stay for a long time in the atmosphere means not enough heat is returning to space, and the Earth is heating up."

8. Distribute HANDOUT 6-A. Tell students that There are nine potential impacts of climate change in Canada. Read them together.
9. On this handout, have students fill in the names for each province. They may need to use atlases for this activity. When they are finished, tell students to write down next to each potential impact what province each prediction might occur.
10. As students complete HANDOUT 6.A, give out HANDOUT 6.B (you could also photo copy on the back side). On this handout, students choose four of the climate change impacts and draw one in each box including a title for each box.
11. Leave ten minutes of the class to perform this last step. Under the title "The Problem", students compose the answer to "Climate change is...". Copy onto primary chart paper and post in the classroom.

Closure: Creati ve writing assignment:"Life in the year 2100"

As a result of climate change, scientists are predicting that the Earth's average temperature will rise between 1.5 -4.5°C over the next 50 years. This doesn't seem like a lot, but when you compare it to the last Ice Age which took place 10,000 years ago, it was only 5°C cooler than average temperatures now! A matter of degrees could make a huge difference! Write a story about life in the year 2100. Choose one of the following topics:

1. Compose two versions of life in the year 2100 according to a girl or boy your own age: one is optimistic because climate change is prevented, and one is pessimistic because climate change cannot be stopped. In the optimistic version: how did we manage to stop climate change, how did our lifestyles change. In the pessimistic version: how has life changed, do we still eat the same foods, how do people keep their houses cool, etc.?

2. From the perspective of a small animal or a vegetable, write two versions what their life is like in 2100 from an optimistic and a pessimistic view. In the optimistic version: how was climate change avoided, why are they happy that climate change was avoided? In the pessimistic version: how has their life changed, did their habitat change, did they have to move further north,did they have to change their food sources?

These stories can be completed as a homework assignment, and read in class the next day.

Extension:

- Consider producing a poster, mural or display to educate the school on climate change.
- Design an international greenhouse logo based on the information learned in this chapter.

Climate Change = Climate Chaos

Name: _____

Label each province correctly. Under each climate change impact at the bottom of the page, write down the province or ocean where these changes might occur.

Potential Impacts of Climate Change on Various Regions in Canada

1. Warmer temperatures could cause changes in fish populations. _____
2. Changes in rainfall patterns could increase drought in the Prairies. _____
3. Water supplies in southern Canada could drop significantly. _____
4. Soil degradation and erosion of prairie land may increase due to moisture loss. _____
5. The water levels in the Great Lakes may fall. _____
6. Forest region could shift northward with deciduous (broad-leaved) trees growing as far north as James Bay. _____
7. Many coastal villages could be flooded. _____
8. Inshore fisheries season could be extended. _____
9. Southern Ontario snow seasons could disappear. _____

Source:

A Matter of Degrees:a Primer on Global Warming, Environment Canada.

Climate Change in Canada

Name: _____

Choose four of the nine climate change impacts and draw a picture to correspond with each. Write a title for each picture.

1.	**2.**
3.	**4.**

Chapter Two Overview: **School Transportation Audit – *The Case of The Carl Von Dioxide Gang***

Lesson 7 **Top Secret**

- Students learn of the activities of the Carl Von Dioxide gang and plan how to foil their evil plans.

Lesson 8 **Community Map (Research)**

- Students create a colour coded map of their community, labelling the means of transportation they use daily.

Lesson 9 **Community Hike (Field Work)**

- Students walk the school grounds and the local neighbourhood tallying trees, taking photos or sketches, and discussing ways of reducing greenhouse gas emissions.

Lesson 10 **The Answer**

- Students compile data found in their interview, and draw conclusions.

Lesson 11 **Graphing (The Report)**

- Students create graphs representing audit findings in preparation for their final report.

Note: For the field activity (Lesson 9), invite parents, volunteers, other teachers,etc. to accompany the class as additional adult supervision is required.

Chapter Outcomes: The student will:

1. identify what information is needed to answer the question: "Is your school atmospherically friendly or is it contributing to climate change?";
2. brainstorm and conduct research to find desired information;
3. understand how a scale on a map represents distance;
4. calculate how much CO_2 /day is produced by travelling to school;
5. calculate the total amount of CO_2 the school annually produces through transportation;
6. calculate the total amount of CO_2 the trees on school property can absorb annually;
7. present data on a graph;
8. produce a final report.

Top Secret!

Lesson Seven

Summary: Students assume the roles of Atmospheric Private Investigators (API) to foil the Carl Von Dioxide gang's attempts to further climate change.

Length: 45 minutes.

Outcomes: The student will:
1. brainstorm information required to answer the question, "Is our school atmospherically friendly or is it contributing to climate change?";
2. design a plan to collect data required to answer the above question.

Background: This lesson begins the investigation students will conduct to find out if their school is atmospherically-friendly. The entire section focuses on the balance between the amount of carbon dioxide released by transportation to the school and the amount of carbon dioxide that is absorbed by the trees on the school property. During the brain-storming session, the students will likely come up with other ways to find out whether their school is contributing to climate change. Keep a record of these ideas,and they can be used for independent projects later on.

The following lessons involve role playing to peak student interest.The teacher also needs to get into character to make this strategy effective. The Carl Von Dioxide Gang is actually the group of green-house gases. As an additional challenge, the students will receive one piece of a pictorial puzzle each day. By solving the puzzle, students find out the real members of the Carl Von Dioxide gang.

Post the first of the Puzzle Cards labelled 1-5 which can be found in the APPENDIX. Paste each card onto a different colour of construction paper and post one at the beginning of each lesson throughout this chapter. The answers are:

Card 1:
"we ARE the gloBALL wARMing 3:"

Card 2:
"m + breath -br" = METH + "train - tr" = METHANE

Card 3:
"night + r + mouse - m" = NITROUS

Card 4:
"ox + eye + d" = OXIDE

Card 5:
"ant - t + d" = AND, CFC

Materials: HANDOUT 7-A (Top Secret Brief), HANDOUT 7-B (How do we find out if our school is atmospherically-friendly?), HANDOUT 7-C (The Car Survey), HANDOUT 7-D (Chart: Kilograms of CO_2 Released Annually By a Single Car), Puzzle Card 1.

Procedure:

1. Begin the class by stating that a mysterious document was found in your mailbox.The only instructions you have is that these "Top Secret Briefs" are to be distributed to the class.
2. Distribute HANDOUTs 7-A and 7-B.
3. Ask students to read the brief (HANDOUT 7-A).
4. Students are asked to answer the question: **"Is your school atmospherically friendly or is it contributing to climate change?"**

Tell the students that if they can find evidence that the gang is polluting the atmosphere, then the police can put the gang behind bars.

5. In small groups,ask students to brainstorm what information they require in order to answer the question and to record it on HANDOUT 7-B. Tell students that they should concentrate on carbon dioxide for this investigation since it is the largest greenhouse gas present in the atmosphere. For example, students can question: how much CO_2 is produced by cars and buses, how much CO_2 is absorbed by trees,how do students, teachers,and custodians travel to school, etc. This activity should take about 10 minutes. *(**Note:** the brainstorming session could also be conducted with the entire class).*

Remember to review the rules of brainstorming with the students:

Any idea is okay and is not to be ridiculed.

Every idea should be written down unless the entire group decides they don't like it.

Once the group is finished, then they can go back and cross out the information that will either be too hard to find or is not that relevant.

6. In the second column on HANDOUT 7-B, students brainstorm how they will find the required information.
7. Compile student answers on the board and create a "TO DO" list on primary chart paper. Let them know that you are going to narrow down the list to focus on transportation and tree information. You can still discuss why their other ideas are important, and let students know that they can look into these ideas on their own.
8. Students should determine that they need to gather the following information:
   - the amount of CO_2 produced from transportation (cars, buses, bikes, and walking)
   - number of trees on school property
   - the amount of CO_2 absorbed by each tree
9. Distribute HANDOUT 7-C, The Car Survey. Students survey an adult in the community who drives to school everyday (this could be a parent, neighbour, staff member, custodian, principal, etc.)
10. Instruct students to ask their adult the six questions found on the handout. Set a due date of two days later.
11. Explain how to use the table found in HANDOUT 7-D which students will need to find out how much CO_2 their car owner produces according to how many km/yr they drive (question #5 in the Car Survey). Consider making it into a wall-chart version, or an overhead to reduce paper.

Closure: Remind students to keep all the handouts and all materials. Explain that the next few lessons follow these themes:

- research
- field work
- the report

Extension: A final report is required. Consider creating folders for students to file their work as a creative arts lesson.

TOP SECRET BRIEF

DO NOT RELEASE THIS INFORMATION TO ANYONE!
IT IS TOP SECRET!

Dear Atmospheric Private Investigator (API),

As you know, the Office of the Atmosphere is planning to release its new carbon dioxide (CO_2) laws next month. The police have been working hard for some time now to stop Von Dioxide's gang from polluting the atmosphere and contributing to climate change. The office hopes that these new laws will help police crack down on the Carl Von Dioxide gang.

Dr. Paul U. Shun, a top government official with the office of the atmosphere has been tied to Von Dioxide's gang. It has been discovered that Dr. Shun, Von Dioxide and the gang are trying to stop the new CO_2 laws from being put into place.

We need you to prove that Von Dioxide's gang is polluting the atmosphere in your community. With the right evidence, we can put these crooks behind bars. We need you to answer the question:

Is your school atmospherically friendly or is it contributing to climate change?

Start by compiling a list of information you need to find and how you can find it.

You will receive clues daily as to the identity of the other members of Von Dioxide's gang.

GOOD LUCK GUMSHOE!

TOP SECRET!!!

How Do We Answer The Question:

Is Our School Atmospherically Friendly???

Group: _____

What information is needed? (Where does the school's CO_2 come from? What's a good CO_2 absorber?)	**How will we find this information?** (Interviews, surveys, fieldwork, etc.)
1. The amount of CO_2 produced by cars travelling to and from school.	1. Interview adults who drive to school.
2.	2.

The Car Survey

Name: _____

Interview an adult from the community (family member, neighbour, teacher, or custodian) who drives to school during the week. Ask him/her the following questions:

1. **What kind of car do you own?**

   _____

2. **What year is your car?**

   _____

3. **What mileage does your car get? (How many litres does it take to travel 100 km in your car?)**

   _____

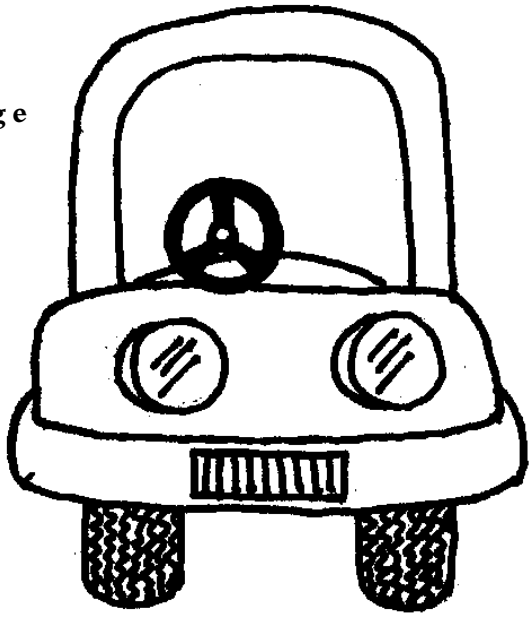
4. **Do you drive your car on a regular basis? (5 or more trips a week)**

   _____

5. **Estimate the distance you travel in your car each year: between 1-14000 km, 14000-26000 km, or +26000 km. (The average Torontonian travels 18 km a day. This information may help you to figure out an approximate number.)**

   _____

   _____



6. **When you drive your car what is the normal number of people in the car? Are you alone, or do you normally have passengers?**

   _____

   _____

Kilograms of CO_2 Released Annually by a Single Car

miles per gallon (mpg)	litre/100 km (l/100 km)	Number of Kilometers/yr*		
		0-14000	14000-26000	26000+
		Kilograms of CO_2/yr		
12	22.5	5000	12500	20000
18	15	3500	8500	13500
24	11.5	2500	6500	10000
30	9.5	2000	5000	8000
36	7.5	1750	4000	6500
42	6.5	1500	3500	5500
48	5.5	1250	3000	5000
54	5	1000	2750	4500
60	4.5	900	2500	4000
mpg	**1/100 km**	4750	12000	20000

***Note:** *These carbon dioxide emissions are approximate.*

Source:

Adapted from *Greening Your Schools* by the Is Five Foundation.

Community Map (Research)

Lesson 8

Summary: Students produce a colour-coded map of their community, indicating which way they travel to school and by what means of transportation (e.g. car, bicycle, walking, etc.). Students then calculate how much CO_2 they produce according to their daily transportation routes.

Length: 45 minutes.

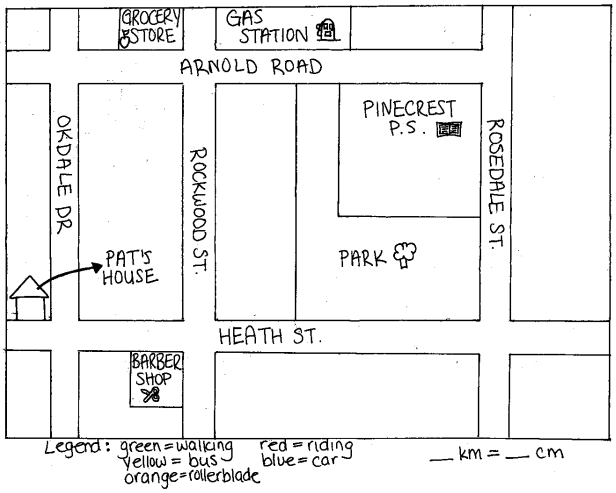
Outcomes: The student will:

1. understand how a scale is used on maps to represent distances;
2. calculate the grams of carbon dioxide produced each day from the students' various means of transportation.

Background: As part of the students''secret investigation', they need to find out how much they contribute by travelling to and from school. The activity is performed through map work and mathematical calculations.

Before this lesson,the teacher needs to produce a simple map of the community to be called the 'Top Secret Map'. Use the following map as an example: draw a map of the streets immediately surrounding the school,labelling the street names and major landmarks (the school, stores, parks, etc.). Street maps such as a Toronto's "Perly's" may be useful. Include a rough scale (e.g. 1 cm = 5 km). Devise a legend for students to label the different modes of transportation they use (e.g. red for bikes, green for walking, yellow for bus or other transit, blue for car, orange for roller blades).

Copy the map and distribute it to the class. Remember to keep it simple. *(Note: If it is too difficult to draw a map, you can also photocopy the appropriate page from a local city map and enlarge it).*



Materials: Map of the community, colour markers (or pencil crayons), HANDOUT 8-A,string, Puzzle Card 2.

Motivation: Climate change is a real problem. Everyone can play a role in the solution.

Procedure:

1. Briefly review student solutions to the first piece of the pictorial puzzle.
2. Return to HANDOUT 7-B and the "To Do" list. In this lesson, focus on transportation.
3. Tell the students that: "Today we will determine how much CO_2 we produce by coming to school everyday."

4. Distribute the Top Secret map of the community.
5. Walk the students through the map pointing out landmarks, and ask the students to label their home on the map.
6. Using the proper colour for bus routes in the legend,ask students to trace onto the map the route they take by bus (if students do not take the bus regularly, they leave the map blank).
7. Using another colour, instruct students to trace a regular route they take with a car to school.
8. Repeat the procedure for walking, biking and roller blading.
9. Explain how to measure the distance they travel:"trace the car line on the map with a piece of string and measure it against a ruler. Then compare the measurement with the scale to calculate the actual distance you take in a car daily. For instance, if your route measures 2 cm, and on the scale 1 cm is equal to 5 kilometres, then 2 X 5= 10 km.
10. Distribute HANDOUT 8-A.
11. On the handout, students record the distance they travel by each means per day and multiply these numbers by the grams of CO_2 produced per km according to each type of transportation to calculate the grams of CO_2 produced each day (13 grams of CO_2/kilometre of walking, 9 gr/km biking, 25 gr/km on public transit, 50 gr/km driving).
12. Once students have calculated how much CO_2 they produce each day, ask them to find out how much CO_2 they produce in the school year (someone will need to use a calendar to count the number of school days in a year).This information will be necessary in Lesson 10.

Closure: Remind students to complete The Car Survey from Lesson 7. Any work that was not completed in class should be done for homework.

Also remind students that next class will be an outdoor fieldwork activity so they should dress appropriately. Students can also bring their cameras for this activity, but it is not mandatory.

Post the second piece of the pictorial puzzle (Card 2).

Title _____ **Name** _____

	Distance	Number of times travelled each day	Total Distance Travelled	Grams of CO_2/Km	Grams of CO_2 produced per day
Bus		**X**	**=**	**X 25 grams**	**=**
Car		**X**	**=**	**X 50 grams**	**=**
Walking		**X**	**=**	**X 13 grams**	**=**
Inline skate/bike		**X**	**=**	**X 9 grams**	**=**

TOTAL _____

Field Work (Outdoor Day)

Lesson 9

Summary: Students first walk around the school ground tallying trees, and then around the local neighbourhood discussing ways of reducing greenhouse gas emissions, taking photos or sketches of good and bad environmental practices. An extension to the activity involves collecting data on car traffic on a busy road.

NOTE: This lesson requires additional adult supervision. Encourage parents, volunteers, or the principal to join you. If a letter is sent home, suggest to parents that cameras will be useful on this trip, and if possible allow students to bring one to class today.

Length: 60 minutes.

Outcomes: The student will:
1. collect data on the number of trees on school property;
2. identify good and bad environmental practices in the surrounding neighbourhood;
3. work cooperatively in an out-of-school activity.

Background: This is the part of the investigation where students count the number of trees on the school property that offset the amount of CO_2 being produced.

Before the lesson, walk the neighbourhood (approximately 0.5 km^2), planning a safe route that includes walking down residential streets to note good and bad environmental practices (see #8 Procedure). For the extension activity, (see below) choose a site on a busier street to observe cars.

If you have extra supervision, you can cover more ground by dividing the class into smaller groups to take different routes.

Materials: HANDOUT 9-A (Tree Count), clipboards, pen, cameras, sketch pads,Puzzle Card 3.

Procedure:
1. Return to HANDOUT 7-B from Lesson 7 and review which tasks have been completed.
2. If you do not choose to do the extension activity, you may place a "✓" beside "transportation", or a similarly worded category on the list.
3. Instruct the class that today they will go on a walk to audit the number of trees on the school grounds. In addition, they will photograph (or sketch) good and bad environmental practices around the neighbourhood.
4. Briefly discuss with students why trees are good for the atmosphere:
   - trees help stop climate change and keep the atmosphere clean;
   - trees absorb carbon dioxide - this is known as a 'carbon sink' (oceans are also very good carbon sinks);
   - but when trees are burned or cut down, they release carbon dioxide.
5. Go over what good and bad environmental practices students should be looking for (see #8).
6. Firmly review your expectations of student conduct while off school grounds - even though they are outside of school, they are still "in-class" and all rules of respect and behaviour still apply.

7. Distribute HANDOUT 9-A. As the class walks around the school grounds, they should tally the number of trees in the "tree count" column. Other green plants, like shrubs, should not be counted.

8. Walk the class through the route. Stop periodically to discuss good and bad environmental practices. Encourage students to evaluate what they see. Below are two lists of good and bad environmental practices:

Bad environmental practices:

- an idling car, school bus, or truck wastes a lot of energy and emits a lot of CO_2;
- a house with outdoor lights left on during the day wastes energy and CO_2;
- a speeding car on a residential road wastes gasoline and disturbs the neighbourhood;
- a water sprinkler left to water grass for a long period of time wastes unnecessary water;
- a home air conditioner that has been left on when the temperature is not that high is also wasteful;
- a car with the windows up is most likely using the air conditioning on a hot day.

Good environmental practices:

- a garden with lots of trees, or a naturalized garden (e.g.a garden with wildflowers, native shrubs and no turf grass)
- a park with lots of trees,especially old trees that have not been cut down;
- an adult walking a baby to the park instead of driving;
- someone biking to the store or to work;
- a house with the curtains shut on a hot day to keep the house cool and reduce the need for air conditioning;
- a letter-carrier biking or walking;
- trees planted strategically along a house (broad-leaved trees along the south side to cool it down from the summer's heat, needle-leaved trees planted along the north side to block it from heavy winter winds).

9. Allow students to take pictures of the community practices, taking good notes of what the picture will represent. Students may choose to sketch what they see if they do not have a camera.

10. Return to the classroom and discuss what you found.Are there many trees? Are there many cars in the neighbourhood? Do many homes have air conditioners?, etc.

11. Students should tally the total number of trees and complete the calculation on HANDOUT 9-A.

12. Place a "✓" for number of trees on the "TO DO" list.

Closure: Remind students that "The Car Survey" must be completed by next class.

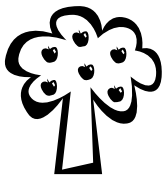
Post Puzzle Card 3.

Extension:

Extension #1: Students audit how many cars pass a certain point and how many passengers each car contains. For this lesson, distribute the "Road Survey" found in the APPENDIX.Choose a site on a busy street. Students tally the number of cars, recording whether the car has one, two, three, or +four passengers by placing an X in the appropriate column. Do this for 10 minutes. Also, record the time of day and the weather. Discuss how these factors affect traffic.

Extension #2: Consider the TTC extension activity, "How does public transit and carpooling save space on roads?" also found in the APPENDIX.

Tree Count



Name: _____

Tally the number of trees in the school yard. Only count trees. Do not count any shrubs. You may want to divide up the school yard into sections. Small groups could be responsible for counting the trees in each section. Keep a tally by drawing a small line '**I**' for every tree you count, i.e. ~~IIII~~

Section One: _____	**Section Two:** _____
Section Three: _____	**Section Four:** _____

Add up the totals to find a GRAND TOTAL: _____

The a verage tree absorbs 22,000 grams of carbon dioxide each year . How much carbon dioxide do all the trees in your sur vey area absorb in a year?

22,000 g CO_2 X _____ = _____

grand total of trees — grams of carbon dioxide absorbed

The Answer

Lesson 10

Summary: The class compiles information gathered from their investigation to find out their school's CO_2 balance.

Length: 15 minutes. (Note:As this lesson is short, plan to introduce Lesson 11 during the same class).

Outcomes: The student will:
1. calculate the amount of CO_2 produced by the school community;
2. answer the big question: Is your school atmospherically friendly or is it contributing to climate change?

Background: Students use the information they have gathered in their investigation to calculate if the school is atmospherically-friendly. As a class, compare how much CO_2 is produced by the students travelling to school, as well as the adults that they interviewed, to the amount of CO_2 that is absorbed by trees on the school grounds.These numbers will obviously be rough estimates and thus, the calculations will not be truly accurate. The majority of classes who do this exercise will find that their is more CO_2 produced by transportation than the amount of CO_2 absorbed by trees on the school grounds. This is yet another way to make students connect their lifestyles with the problems of climate change and to help them see the importance of taking positive action.

Materials: Completed copies of HANDOUT 7-C (Car Survey), [HANDOUT 7-D (CO_2 Chart)], HANDOUT 8-A, and HANDOUT 9-A (Tree Count); , primary chart paper (so the results can be posted in the classroom), Puzzle Card 4.

Procedure:

1. Review what the private investigators' research has revealed up to now.
2. Pose the problem:"We need to see how much CO_2 is produced by teachers and students getting to school." (Note: Make sure when you compare your calculations, you are working consistently in grams or kilograms!)
3. Calculate two totals: ask each student 1) how much CO_2 they produce each year (HAND-OUT 8-A) and 2) how much CO_2 the car owner that they surveyed produces (HAND-OUT 7-C). This is a good opportunity to verify students have completed their homework. Record the two totals on the board
4. Multiply the class total by the number of classes in the school to find out how much CO_2 the entire student body produces. Ask the class to produce a grand total of CO_2 produced per year, by adding the **student total** with the **car owner total.** Record this number on primary chart paper and post it up on the wall.
5. Compare this figure to the amount of CO_2 absorbed by trees (from HANDOUT 9-A). *(Although inaccurate, the estimate should show that more CO_2 is produced by human activity than the trees can absorb)*.The answer could spark a discussion on the value of public transportation. Would the figure be different if everyone took the public transit? Why? <yes, because less CO_2 would be produced>.
6. Ask: "What assumptions we made in calculating this figure?" (e.g. other classes have the same transportation patterns as our class, all trees absorb the same amount of CO_2 , etc).
7. Mention that another limitation to the audit is that the class only looked at transportation as a CO_2 producer. Another big CO_2 producer in

the school is the heating and electrical systems for the building. (If the school is heated on natural gas, then it would be releasing methane gas instead). Ask a pair of students to go and ask the custodian how the school is heated.

8. Review the contents of their written report according to what has been completed to date (check evaluation below).

Closure: Post Puzzle Card 4 on the board.

Extension: Students are to produce a written report of their findings. It should include:

(The students should have or should be able to complete those items with checks in front of them by the end of this lesson).

1. ✓ What is the problem with the greenhouse effect (one paragraph).
2. ✓ What question did the investigator set out to answer.
3. ✓ A description of what research was completed.
4. ✓ Summary of research findings (including HANDOUT sheets).
5. ✓ A conclusion, answering the research question.
6. **Three graphs:**
   - **i.** The fuel economy of the cars surveyed (to be completed in Lesson 11);
   - **ii.** CO_2 produced by the school versus CO_2 absorbed by local trees (calculated in this lesson);
   - **iii.** The amount of CO_2 the student produces from different transportation types (HANDOUT 8-A).
7. A paragraph pointing out the limitations of the study (and suggested improvements).
8. Cover page, table of contents, photos or illustrations with a detailed description of what the figures show, and all HANDOUTS.

Graphing (The Report)

Lesson 11

Summary: Students compile bar graphs from the information gathered on their investigation.

Length: Two 45 minute math lessons.

Outcomes: The student will:
1. produce three bar graphs;
2. understand what kind of information is best represented by a bar graph;
3. discuss ways of reducing CO_2 from automobiles.

Background: Students will produce three graphs for their report submission. Today they will discuss how to produce a graph and complete the first one.

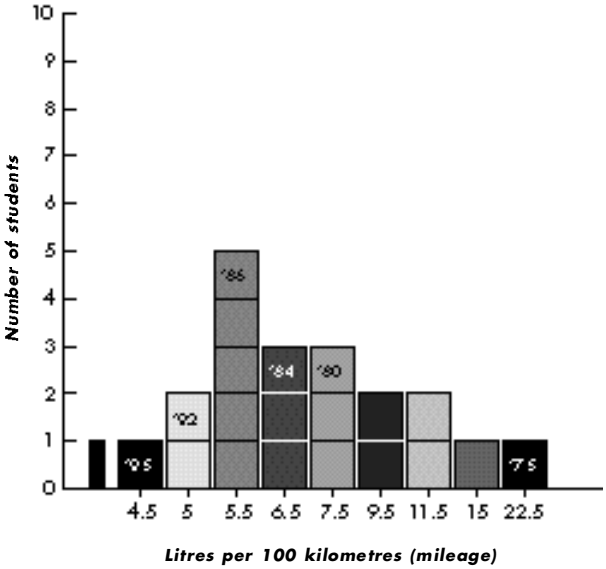
Corporate Average Fuel Economy (CAFE) standards were established in 1975 to force car manufacturers to produce more fuel efficient vehicles. Car manufacturers average out the fuel efficiency levels of all the models they produce to determine their corporate average. The current CAFE standard for domestic cars is 10 litres/100 km (27.5 miles per gallon). In order to sell more of the expensive gas guzzling luxury cars, manufacturers sell many of their fuel efficient models at or below cost to maintain their CAFE average.

Materials: Large sheet graph paper, marker, graph paper for students (1 cm grid), completed HANDOUT 7-C (The Car Survey).

Procedure:

1. Ask a few students for the efficiency of the car they surveyed (if efficiency was reported in miles per gallon (MPG), students can use HANDOUT 7-D to convert figures into litres/100 km).
2. Point out that numbers in isolation are hard to understand - we need a better way of seeing data.
3. Ask for suggestions. Prompt students to be more specific than saying simply a graph.
4. Discuss the advantages of a bar graph for showing litres/100 km (l/100 km) on the X-axis and number of cars on the Y-axis.
5. Set up a sheet with litres/100 km on the bottom in increments of 5, 10, 15,20, 25, 30 (Graph 1).

Graph 1:



❶ A bar graph representing the fuel efficiencies of the cars surveyed (HANDOUT 7-C)

6. On the vertical axis write "number of students". Label each square from one to the total number of students in your class.
7. Ask the class if anyone's car uses 5 litres/100km (litres/100 km). Each student with 5 litres/100 km comes to the front and colours in one square. In the square, they write the year the car was manufactured.
8. Repeat the procedure for 10,15, 20 litres/100km,etc.
9. Once the graph is complete, discuss with the class what average litres/100 km most cars in the class get.
10. Discuss whether older cars receive better or worse fuel efficiency (they should be worse).

NOTE: When dealing with units of litres/100 km, the lower the number, the more fuel efficient the car. On the graph, the fuel efficient cars will be on the left side of the graph and the gas guzzlers on the right side.

11. Discuss ways of reducing CO_2 emissions from cars:

    manufacturing process
    - improving fuel efficiency on all cars

    while driving
    - drive slower, and accelerate from a stop gradually
    - keep the windows up and the vents open to keep cool when driving on the highway
    - combine errands instead of taking many trips
12. Discuss CAFE standards.
13. Instruct students to copy the graph onto a sheet of graph paper. Remind students to label the 'x' and 'y' axis of the graph and to give their graph a title.
14. Review the following graphs to be completed the next day:

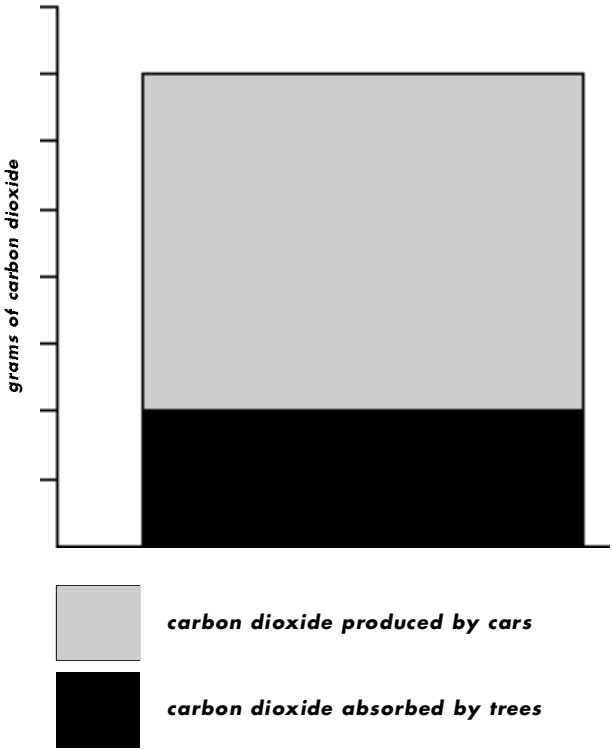
    ❷ A bar graph representing carbon dioxide produced by cars vs carbon dioxide absorbed by trees. (Information calculated in Lesson 10.)

    ❸ A bar graph representing the students' mode(s) of transportation vs the grams of carbon dioxide produced per day (HANDOUT 8-A). Consider pairing students together with students who use different modes of transportation in order to see a range on their graphs.

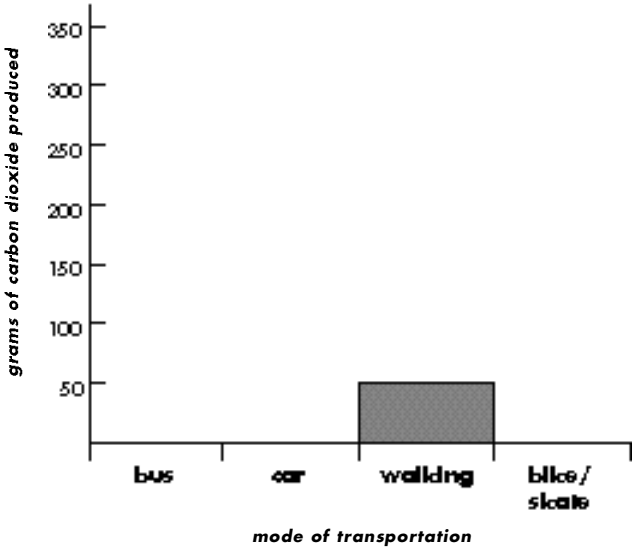
    If the class performed Extension #1 in Lesson 9:

    ❹ A bar graph representing the number of cars surveyed vs the number of passengers in each car.

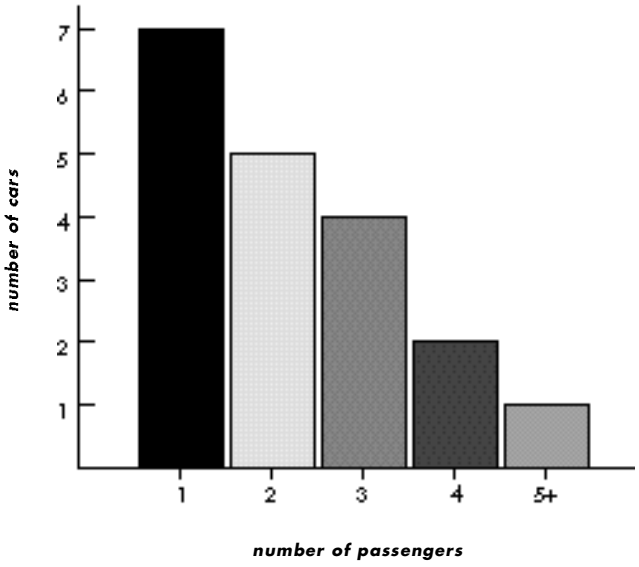
Graph 2:



Graph 3:



Graph 4:



Closure: Review expected report submission and due date.

Post the last card of the pictorial puzzle in the classroom. See if students have figured the puzzle out (the answers can be found in the Background section of Lesson 7).

Extension: Encourage students to produce graphs using a computer spreadsheet program.

Present the information found during this 'private investigation' in a public forum, such as holding an assembly and inviting parents, local government officials and the rest of the school. A presentation of this kind would give credibility to the students' work and give more meaning to the information that they find.

Chapter Three Overview: **Energy Use in the Home**

Lesson 12 **Energy Use: Yesterday and Today**

- Students brainstorm and read a story on energy use today and in the past.

Lesson 13 **Energy Saving Action Plan**

- Students complete an energy efficiency report, and develop an action plan for reducing energy use.

Chapter Outcomes: The student will:

1. appreciate that energy use has changed in the past hundred years;
2. complete an energy efficiency report of their home energy use;
3. develop an action plan for reducing energy use.

Energy Use: Yesterday and Today

Lesson 12

Summary: Students brainstorm their daily energy consumption and read a story comparing energy use today and in the past.

Length: 45 minutes.

Outcomes: The student will:
1. read a story called "Times Have Changed";
2. describe three ways we use energy differently than people did one hundred years ago;
3. appreciate that the people in the past did not have such high energy use;
4. chart on a time-line how much energy they use every day.

Background: Students will consider energy use in the past, and compare it to how much they use. In the next, students will audit their homes and create an "Action Plan" for reducing energy use.

If less wealthy students are embarrassed that they do not have as many appliances in their homes, remind them that Canadians use too much energy, so having less "stuff" is better for the environment.

Materials: HANDOUT 12-A ("Times Have Changed"). Consider turning this handout into an overhead to reduce paper use).

Procedure:

1. Before class, place the following country names on the board: United States, Singapore, Canada,Australia and Czechoslovakia.
2. Ask students to guess which country produces the most CO_2 per person - called 'CO_2 per capita' (you may want the students to locate the countries on a world map).
3. The correct rank is:

I	United States	19.74 tonnes of CO_2/person
II	Canada	15.72 tonnes of CO_2/person
III	Australia	15.55 tonnes of CO_2/person
IV	Singapore	13.88 tonnes of CO_2/person
V	Czechoslovakia	13.47 tonnes of CO_2/person

(Source: Carbon Dioxide Analysis Center, 1992)

4. Review with students that climate change is a problem.Canadians are one of the largest per capita energy users in the world. Homes have been described as "greenhouse gas factories".
5. Divide the class into groups of four.
6. Each group should designate a recorder to write ideas down, and a spokesperson to present ideas to the class (you may assign roles, or allow students to decide).
7. Ask students to brainstorm on all the ways they used energy that morning (e.g. taking a shower, turning on the lights, cooking breakfast, walking to school, etc.).
8. Have the spokesperson from each group present their group's ideas.

9. Distribute the story "Times Have Changed!" (HANDOUT 12-A).
10. Read through the story.
11. Create your own questions about the story, or use the questions below.
12. Compare how so many more things we do today require the use of electricity compared to 100 years ago. For example; to listen to music, we turn on the radio; to watch entertainment, we turn on the T.V.; to heat our homes, we use a furnace, etc.
13. What is the source of all this electricity? <In Ontario, it is nuclear power, coal, gas,and hydro. All around the world there are large coal-burning plants that burn fossil fuels to generate heat and electricity for peoples' homes, work and school.> Ask students if they can think of any examples of appliances which do not use electricity but still need oil or gas to work? <Barbeques,stoves and lawnmowers>
14. Try to make the connection with students that when they plug their toaster into a socket,the electricity does not magically appear. Instead, humans are burning fossil fuels day and night to supply the world with enough energy. Also, fossil fuels will not last forever; there is only a finite amount of coal, oil and gas buried under-ground. (There are other sources of energy such as nuclear power and renewable sources like solar power which will be addressed in chapter four. More information on fossil fuels is also provided in chapter four).

Closure:

1. What is created when we burn fossil fuels? <Carbon dioxide>. Then how does using a clothes dryer and dish washer contribute to climate change? <Fossil fuels have to be burned to produce electricity to use these appliances, and they pollute the air with unwanted greenhouse gases>.
2. List at least three things a modern kid can do to reduce energy use.
3. For the remainder of the lesson, students create their own time-line for how they use energy in a typical day. They should note when they wake up, and what energy using devices they use before coming to school. Continue the energy time-line from after school until they go to sleep. Discuss how a typical day might be different for a girl compared to the boy in the story. If these time-lines are not completed in class, they should be finished as a homework assignment.

Extension:

1. Students interview their grandparents or elders to find out how energy use differed when they were young.
2. Write a story about how we will use energy one hundred years from now.

Questions for Times Have Changed:

1. What is a "chore"?
2. What does "hand mending" mean?
3. Why did the child of the past chop wood?
4. Which child, from the past or the present, gets more sleep?
5. When labour saving devices like vacuum cleaners and automatic toasters were created, many thought they would make our lives simpler. In your opinion, which child, from the past or present, has the simpler life?

Times Have Changed

We haven't always used so much energy. Only one hundred years ago, perhaps when your great-great-grandparents were growing up, life was quite different.

In fact, a typical winter day might have gone something like this:

5:30 a.m. Hear early-morning sounds of father down in kitchen, throwing more wood into stove (only source of heat in house).

6:30 a.m. Get up when morning light streams through window. Your room is so cold that you can see your breath. Wooden floor feels freezing cold on your bare feet. Quickly put on several layers of clothing and go downstairs. Rush outside to outhouse to go to bathroom.

7:00 a.m. Porridge is bubbling on wood stove. Cut thick slice of bread and clamp between two wire racks. Place over open stove top to make toast. Get butter out of ice box. Fetch potatoes, squash, carrots and onions from cellar and cut up for stew for dinner, which will sit cooking all day while warmth from stove heats house.

8:00 a.m. Gather up books and leave house for 45-minute walk to school.

9:00 a.m. Put container of milk in stream by school to keep cool. Help gather wood for stove that keeps schoolhouse warm.

Times Have Changed

3:30 p.m. Walk home to do chores. Sweep floors. Chop wood for stove and bring into house. Take dry clothes off line and fold or iron, using iron heated on stove.

5:00 p.m. Light oil lamps as it begins to get dark. Eat dinner while discussing chores to be done next day.

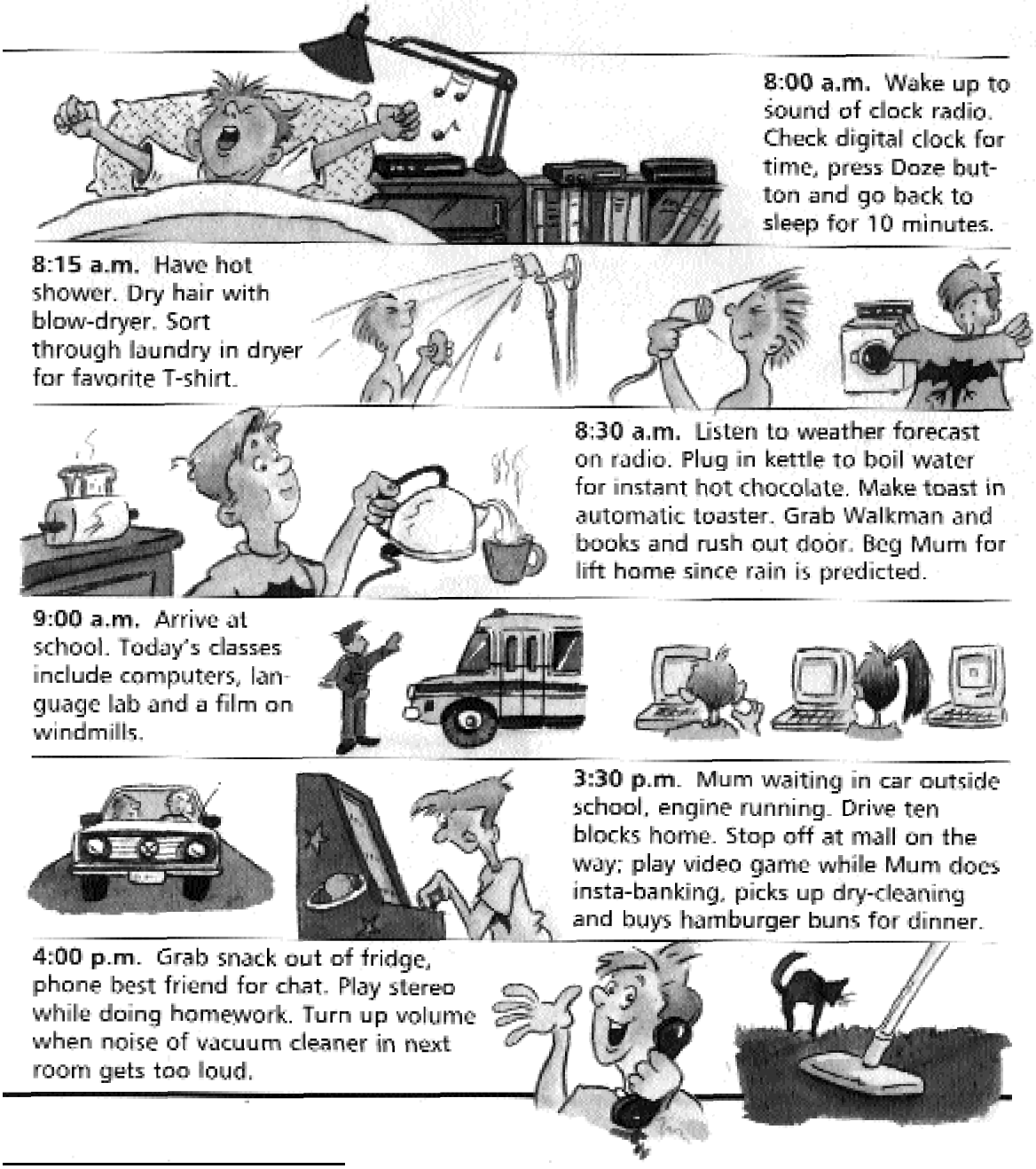
5:30 p.m. Pour hot water from pot on stove into dishpan. Wash dishes by hand and dry them with dishcloth. Cover bowl of leftover food with tea towel and place in unheated room next to kitchen to keep cool.

7:00 p.m. Do homework by light of oil lamp. Get out skates and polish so they will be ready when pond freezes over after Christmas. Do hand mending. Write letters. Fill hot-water bottle with hot water and run upstairs to put under covers to warm bed. Hurry back down to warm kitchen.

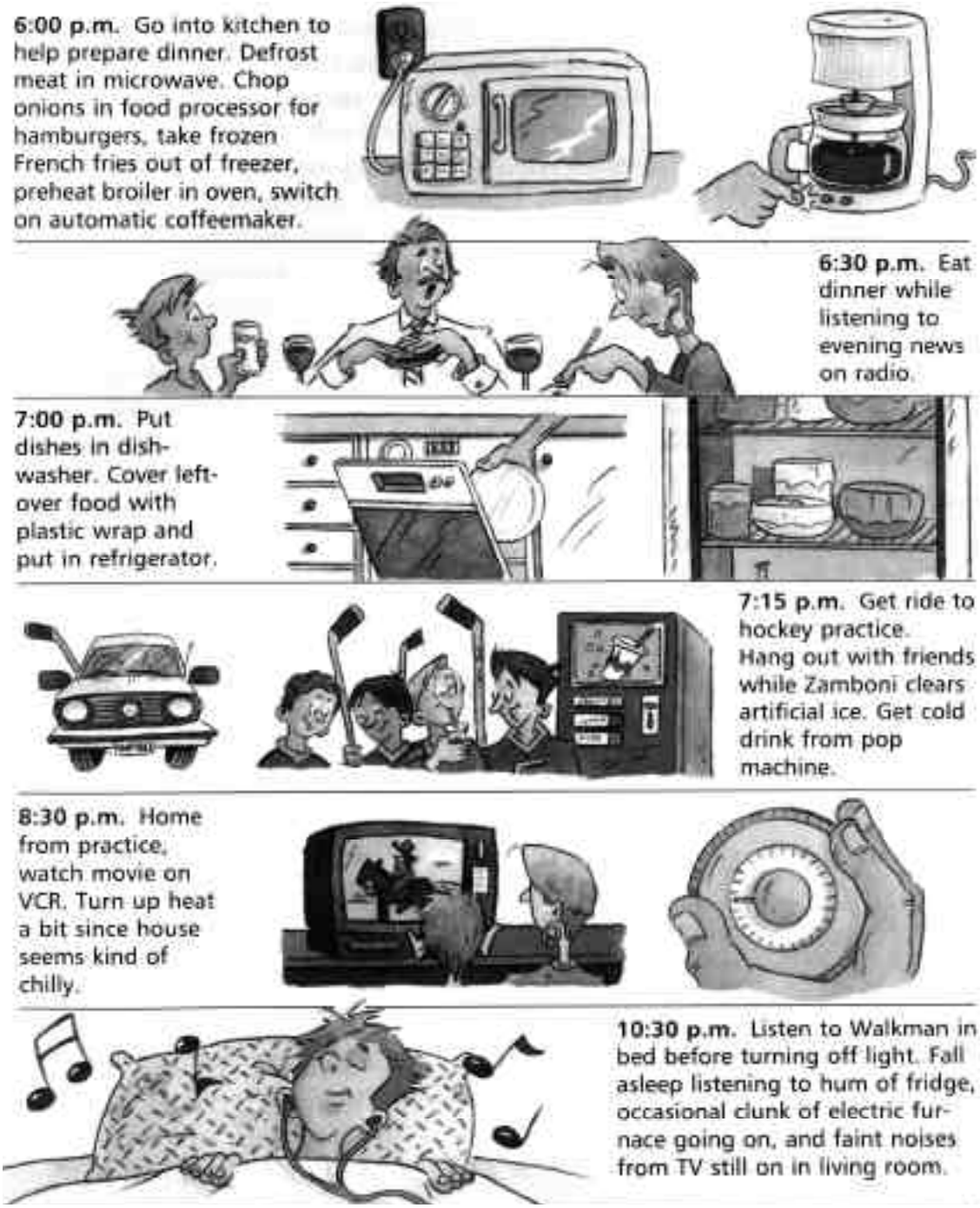
8:30 p.m. Eyes getting sore from reading in dim light. Go upstairs and quickly get into bed. Sounds drift up through hole in floor that lets heat rise up from kitchen into your room. Fall asleep to sounds of parents putting more wood into stove for the night before they go to bed, too.

Times Have Changed

On the other hand, a typical kid's day today would be quite different:



Times Have Changed



The Home Energy Saving Action Plan

Lesson 13

Summary: Students complete a report card on their energy use and develop an action plan for reducing energy.

Length: 40-50 minutes.

Outcomes: The student will:
1. understand that using energy in the home contributes to climate change;
2. complete an energy efficiency report on their energy use;
3. identify five ways energy can be wasted in the home;
4. design a home energy action plan.

Background: As the old saying goes:"Education starts in the home". In this activity, students can begin to teach their families about energy efficiency by encouraging them to follow their action plan. The Home Energy Saving Action Plan is also a good way of applying the concepts learned in class into students'daily lives. An excellent complementary activity would be to develop an action plan for your class or the entire school!

To get a better idea of what one can do to save energy, read the "Energy Efficiency Tips" in the APPENDIX section as it provides a comprehensive list of energy-saving actions throughout the house.

Materials: HANDOUT 13-A (Home Energy Efficiency Report),HANDOUT 13-B (I am an energy wizard pledge), HANDOUT 13-C (Congratulations Certificate),"Energy Efficiency Tips" in the APPENDIX.

Procedure:

1. Review the question:"How does using a clothes dryer and dish washer contribute to climate change?" <Electricity production involves burning fossil fuels which adds CO_2 and other greenhouse gases to the atmosphere>
2. Distribute the "Home Energy Efficiency Report" (HANDOUT 13-A).
3. Students put today's date in the first column, and answer the questions according to the numerical scale (for example, if students always turn off the lights, they put a 10 in that column).
4. Review results of the quiz. Discuss what increasing energy efficiency means <to reduce the amount of energy you use, either by using certain appliances less or by exchanging them for energy efficient products>.
5. Tell students that to improve their energy use, they will now design an energy saving action plan. If the students wrote an energy time-line in the last lesson, they can use it now to see where they can improve their energy efficiency. Otherwise, use the list of "Energy Efficiency Tips"in the APPENDIX. Students can use these options to decide on three areas that they will concentrate on. Have some student helpers create a large chart of these tips to post around your class or in the hallway.

The action plan includes:

- a completed "Energy Efficiency Report"
- a completed pledge form (HANDOUT 13-B) stating:
  - three areas where the student will save energy
  - the date of the "Energy Efficiency Report" to be revisited to evaluate the success of the plan (choose a date a few months ahead. This could be an excellent Earth Day activity in April.)

6. The teacher and the student sign the pledge (HANDOUT 13-B).Ask students to post the pledge at home so all family members can see it.
7. "Find The Energy Waste" handout can be found in the APPENDIX as an additional activity for quick students.

Closure: Develop an Action Plan for your class. Decide on at least five actions. Create a rotating list of students to monitor these actions.

Extension:

- To complement the student's energy saving actions at home, use the "Light Patrol" handout found in the APPENDIX to monitor unnecessary use of lights around the school.
- After revisiting the Home Efficiency Report Card at a later date, ask the principal to sign the "Congratulations Certificate" (HANDOUT 13-C).

Evaluation: The Energy Saving Action Plan can be evaluated by the depth of thought, how realistic it is, and eventually the success of the plan.

The One-Negaton-CO_2 Lamp

When you prevent a ton of CO_2 from entering the atmosphere through energy efficiency, you have created a "nega-ton".

A single 18-watt compact fluorescent bulb produces the same light as a 75-watt incandescent bulb. The compact fluorescent lasts approximately 13 times as long,and saves 570 kilowatt hours of energy over its lifetime.

This one bulb will:

1. Avoid the emission from a typical U.S. coal plant of:
   - a tonne of CO_2, which adds to climate change;
   - 8 kg of SO_2, which contributes to acid rain;
   - NO_x, heavy metals and other pollutants.

AND

2. This bulb which typically is sold for $15-18 saves:
   - the cost of a dozen ordinary bulbs and their installation labour;
   - $20 worth of electricity.

Energy Efficiency Report Card

Name: _____

Always = 10
Usually = 8
Sometimes = 5
Almost Never = 3
Never = 0

Electricity

	Date 1	Date 2
I turn off lights I'm not using (and when I leave the room).		
I use natural light (sunlight) whenever possible.		
I turn off the T.V.,radio or stereo when I'm not using them.		
I stand with the refrigerator door closed deciding what to eat.		
My family only washes full loads in the washing machine.		
My family uses the clothesline whenever possible instead of using the dryer.		

Water

I keep water in the refrigerator to keep it cool instead of running the faucet.		
I turn off the water while I'm brushing my teeth or sudsing up my hands.		
I shower instead of bathing and save up to 40 litres of water each time.		
If I wash dishes by hand,I don't leave the water running to rinse each one separately, or if I use a dishwasher, I only run it when full.		

Score Totals

190 +	"You're an energy wizard!"
165-189	"Great Stuff-- apprentice wizard"
100-164	"Good start, but room for improvement"
60-99	"Time to get started on energy efficiency"
0-59	"You're an energy HOG!"

Heating and Cooling

I wear extra warm clothing in winter instead of asking my parents to turn up the heat.		
I ask my parents to turn the thermostat down at night and use extra blankets instead.		
In the winter, I open curtains when the sun is shining and close them when it's not.		
On warm summer days, I close the curtains when the sun is shining to keep the house cool.		
I do not use an air conditioner unless it is very, very hot or I do not use an air conditioner at all.		
I keep doors and windows shut while the air conditioner or the furnace is working or just to prevent cold draughts coming into the house.		
I do not stand in the doorway with the door open to talk to someone.		

Transportation

I ride my bike (or walk or take the bus) whenever possible instead of asking for a drive.		
I carpool with my friends'whenever possible.		
I use public transit.		
I remind drivers who are waiting for me to turn off their engine.		

ADD YOUR TOTAL →

Date 1	Date 2

I am an Energy Wizard

I promise to do the following to reduce my energy use:

1. _____

2. _____

3. _____

On _____, _____, I will redo my "Energy Efficiency Report" and see if I have increased my score of _____.

_____ **Student Signature**

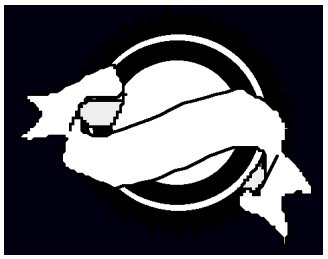
_____ **Date**

_____ **Teacher Signature**

CONGRATULATIONS

You have reduced your energy use and have helped slow down Climate Change.

Keep up the good work!



Date _____ **Signature** _____

Chapter Four Overview: **Exploring Energy Sources**

Lesson 14 **Research**

- Groups research energy sources to present information to the class.

Lesson 15 **TV Persuasion**

- Students learn about persuasive techniques used in TV commercials and design their own advertisement for their energy source.

Lesson 16 **On With the Show**

- Students present their TV ads, and the class critiques them.

Chapter Outcomes: The student will:

1. state three advantages of five energy sources;
2. state three disadvantages of five energy sources;
3. research an assigned energy source;
4. work cooperatively in a group;
5. critically analyze persuasive techniques used in television commercials;
6. design a two minute group commercial on their energy source;
7. present the commercial to the class;
8. critically evaluate each commercial.

Research

Lesson 14

Summary: Groups research energy sources (fossil fuels, nuclear, hydro, solar, wind, biomass), and in the process, students learn how to take point-form notes.

Length: 45 minutes.

Outcomes: The student will:
1. list six energy sources (fossil fuels, nuclear, solar, wind, biomass and hydro);
2. list three advantages of an assigned energy source;
3. list three disadvantages of an assigned energy source;
4. explain how the assigned energy source is created;
5. practice the concept of making point-form notes.

Background: Currently only a few energy sources are being used to provide Ontario's electricity. Historically, Ontario has been reliant on coal, hydro and nuclear sources of power. Ontario Hydro is considering adding more renewable power to its current mix of sources.The class will research these renewable sources.

If you choose to have students do their own research, you will need to access the school's library for encyclopedias, books, magazines, industry published material, CD-Rom,videos etc. Coordinate this project with the teacher-librarian and provide him/her with the Energy section in the RESOURCE section.

Materials: HANDOUTs14-A,B,C,D,E,F,G (make a copy for every student of 14-A and B, also copy 14-B into an overhead, and only make 4-5 copies of 14-C,D,E,F,G), overhead projector, erasable colour markers, black board and chalk.

Motivation: Where does the energy that comes out of the socket come from?

Procedure:

1. List the following words on the board: fossil fuels, nuclear, and wind.Ask what all three have in common. <Sources of energy>
2. List the following words on the board: fossil fuels, nuclear, wind, electricity, hydro, biomass. Ask "Which of these are sources of energy we can use?" <All except for electricity, because it is not a source of energy but a byproduct>
3. Explain that the class will research an energy source.
4. Distribute HANDOUT 14-A and 14-B (Fossil Fuels).
5. Ask a student to begin reading.After a few sentences, call another student's name to continue reading.This forces all students to read along in case they are chosen to read aloud.
6. Explain to the class that they must read the information in order to answer the questions.
7. Turn on the overhead projector and reread 'Fossil Fuels' on the overhead.Ask for a volunteer to highlight in a coloured marker a key word or phrase that describes what is the energy source. Have students mark their own sheets. Ask the student to turn away from the overhead and paraphrase the energy source in his/her own words and to write it on the black board. Have students copy it down at the bottom of the handout.
8. Ask another volunteer to highlight in a different

colour the key phrases that describe the advantages of the power source on the overhead and to paraphrase these advantages on the black board in point form style (not real sentences).

9. Ask a third volunteer to highlight in a third colour the key phrases that describe the disad - vantages of the power source on the overhead and then paraphrase them on the black board. Explain to the students that this a helpful way to take notes while reading through information - first you read through the entire article, then you highlight key words or phrases, and then you write the highlighted information in a notebook in your own words so that you will understand it the next time you read through your notes.
10. Instruct the class to follow the same format while reading the fact sheet on their energy source or during their research.
11. Divide the class into 5 groups.
12. Assign each group (or let them choose) one fuel source to research:
    - nuclear
    - hydro-electricity
    - wind
    - solar
    - biomass (vegetation, e.g. firewood)
13. Have the groups complete HANDOUT 14-A.
14. (At this point, you may either choose to provide students with the fact sheets on the energy sources, or have the students do the research themselves.)

Closure: Instruct students to collect or produce pictures and graphics of their energy source.

Extension: Students can produce a display of their energy source, like a small model accompanied by a concise explanation. For example, students investigating wind energy could construct a wind turbine out of popsicle sticks. Students investigating biomass energy could build a burning site for vegetation out of plasticine.

As part of the research,consider a guest speaker or a field trip. See the RESOURCE section under Energy.

Evaluation: The evaluation in this chapter will be ongoing. As an end-product, groups will produce a T.V. commercial on their energy source.

Where Does Our Energy Come From?

Name: _____

Energy Source: _____

1. **Descr iption of Energy Sour ce:** Describe the energy source in a couple of sentences (i.e. where does it come from, where is it used, etc.)

_____

_____

_____

_____

_____

2. Three advantages of this source are (distinguish whether they are environmental or economic):

1) _____

_____

_____

2) _____

_____

_____

3) _____

_____

_____

3. Three disadvantages of this source are (distinguish whether they are environmental or economic):

1) _____

_____

_____

2) _____

_____

_____

3) _____

_____

_____

4. Is this a practical energy source? Why or why not?

_____

_____

_____

_____

_____

_____

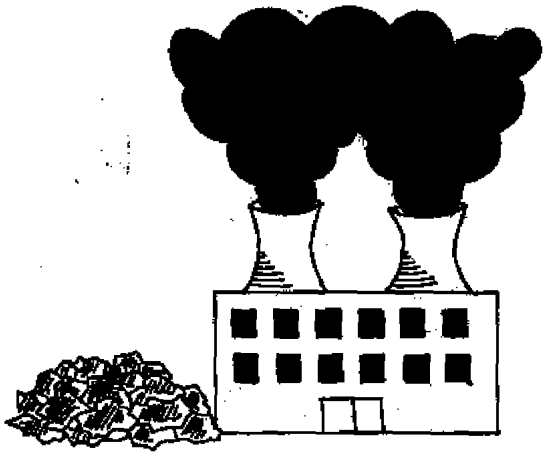
Fossil Fuels

There are many types of fossil fuels. They include petroleum, oil, natural gas, coal and others. Fossil fuels all come from decayed plant and animal matter from millions of years ago.

When dinosaurs and ancient plants died, they were covered by earth or water. These plants and animals decomposed very slowly. The resulting substances from this decomposition process burn very well.

Fossil fuels are burned to produce heat, create electricity, run cars and drive machines.

The advantage of fossil fuels is their low cost. Oil and natural gas can be pumped from the ground. Many countries have huge coal deposits that can be mined.



Fossil fuels are portable. They can be transported in trucks over large distances. Currently, the fossil fuel, petroleum, is the only practical energy source for cars, known as 'gasoline'.

Unfortunately, fossil fuels are not clean energy sources. For every litre of gasoline burned, a large amount of carbon dioxide (CO_2) and other gases are released into the atmosphere. Even natural gas, which burns cleaner than oil, releases CO_2 and another greenhouse gas called methane.

Oil spills, such as the 1989 Exxon Valdez disaster in Alaska, cover shorelines and animals with thick, heavy oil. Every year more than 100 oil spills occur world-wide, releasing millions of litres of oil.

Cars release pollutants that often form smog in large cities. Smog (comes from the words: 'smoke' and 'fog') is harmful to breathe, causing health departments to issue warnings on hot, humid summer days, especially to people with respiratory problems (like asthma).

The burning of coal releases sulphur and nitrogen which creates acid rain.

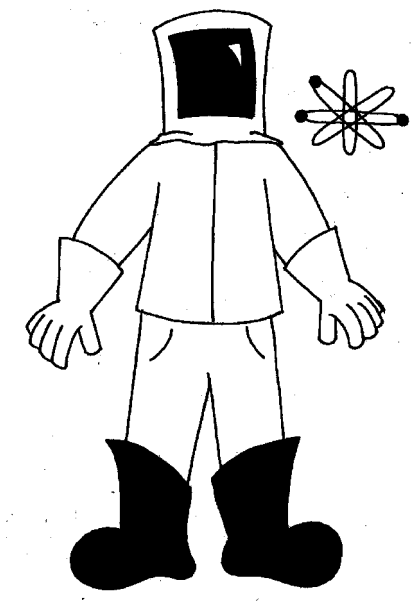
Our huge need for fossil fuels means the supplies we have now will not last forever. Humans are consuming these fuels 10 million times faster than nature can create them!

Gardiner, Brian. Energy Demands.
Gutnik, Martin. The Energy Question: thinking about tomorrow.

Nuclear Power

Nuclear power is very different from other energy sources. Instead of burning something, nuclear power uses the energy found in atoms.

Atoms are tiny components of matter that make up everything on Earth. In the nuclear power process, when atoms from the element **uranium** are split apart the energy that held them together is released as heat. This process is similar to, but more controlled than, an exploding nuclear bomb.



The energy from this process heats water so it converts to steam. The steam turns huge turbines which produce electricity. In 1996, about two-thirds (66%) of the electricity used in Ontario came from nuclear power plants.

When nuclear power was first introduced 50 years ago, it was seen as the answer to all of our energy problems. It did not emit carbon dioxide, sulfur dioxide (principal chemical in acid rain) nor any chemicals that lead to smog. Only a little bit of uranium was needed to produce a large amount of energy. In fact, a piece of uranium that is smaller than a golf ball can produce as much energy as 20 railway cars full of coal!

But there are many problems associated with nuclear power. Nuclear fuel produces harmful radiation, which can make people very sick. Nuclear accidents, such as the one in 1986 in Chernobyl, Ukraine killed humans, animals, plants and polluted the soil and air with radioactive chemicals. In the Chernobyl example, cows as far away as Finland and Sweden became sick from the radiation released by the accident.

Safely disposing of radioactive waste is a major concern. The rods that hold the uranium are radioactive. They remain radioactive for tens of thousands of years. So far, no safe place has been found to dispose of these rods, and it is unlikely that any method will be 100% safe.

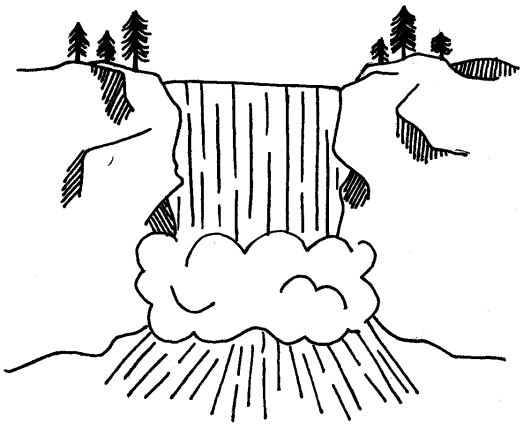
Nuclear plants are expensive to build and only last for 40 years. Also, people do not like having nuclear plants close to their homes because of the potential health risks.

Bailey, Donna. Conserving Energy.
Gardiner, Brian. Energy Demands.

Hydro-Electricity

Moving water has been used as an energy source for hundreds of years. The Romans were the first to use water-wheels. In the eighteenth century, water-wheels powered mills that ground corn into flour. Today we use water to produce electricity.

Fast-flowing water is used to turn turbines. These turbines are connected to generators, which produce electricity. This is how a hydro-electric station works (hydro is another word for water). Ontario gets 10% of its energy from hydropower. The most well known site is Niagara Falls.



Large hydro-electric stations need great amounts of water flowing rapidly. Dams are created to accomplish this rapid water flow. An artificial lake (called a reservoir) is created by building a dam to stop a river from flowing. Water is released through the dam and it turns the turbines.

Water as an energy source is cheap and renewable (it will not run out like fossil fuels). Hydroelectric stations produce no waste, no air pollution,and no greenhouse gas emissions.

In order to produce large amounts of electricity, however, large dams have to be built. These are extremely expensive. Also when building the dams, land has to be flooded in order to create reservoirs. Local people may be forced to move from their homes, and the natural environment is changed, damaging animal,fish and plant habitat.

Although dams do not create air pollution,they cause water pollution. Minerals from the soil and rocks may leak into the water and poison the fish and the humans who eat them. Also, the reservoirs can become stagnant (there is no flow and no new water) and as a result insects and water-born diseases appear.

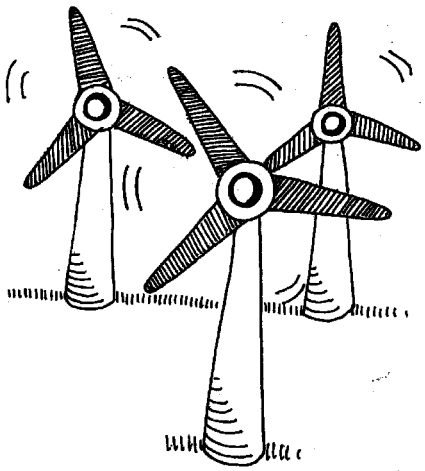
Small hydro-electric power stations that do not disrupt a river's ecosystem are a good alternative to large dams.

Knapp, Brian. Don't Waste Energy.
Tesar, Jenny. Global Warming.

Wind Power

Wind power is one of the oldest forms of energy. People have been using wind energy to propel ships, drive windmills, and fly kites for centuries.In Holland, wind was used instead of water to drive mills. "Windmills" were used to grind wheat into flour.

Today we use windmills to produce electricity. A windmill, or wind turbine, turns a generator which then produces electricity. Modern wind turbines have 2 or 3 blades made out of high-tech materials such as carbon-fibre composites.



The best thing about wind power is that wind is free and renewable, unlike fossil fuels and nuclear power. Wind power creates no air pollution or greenhouse gases.

Each individual wind turbine needs little space and it can be built on land that has no other useful purpose. Wind power can also be used in simple ways, like designing buildings so open windows and vents produce natural cooling.

One wind turbine produces a small amount of electricity, so hundreds of turbines are built in what are called "wind farms".These farms may take up hundreds of hectares of land. Many people complain that wind farms are ugly and noisy. Also, although the wind itself is renewable, the turbines needed to harness the wind are currently very expensive.

Even a large wind farm does not always produce a large amount of energy. The power produced varies depending on how strong the wind is blowing.

The amount of wind in an area varies around the world. Some places do not get strong enough winds to propel the turbines, making it an inefficient source of energy. The level of wind in an area is called a 'wind regime'. Toronto has a 20% wind regime capacity. California receives high levels of wind and they have a 100% wind regime capacity.

Wind power can be hooked up anywhere on an grid system*. So, if a wind farm is built in northern Ontario, homes in southern Ontario can still access it, as long as they are hooked up to the same electrical grid system.

Ontario Hydro is starting to test the use of wind power throughout Ontario, and to improve the technology so that it will be less expensive for people to buy. Maybe one day, all of our household electricity will be powered by wind turbines.

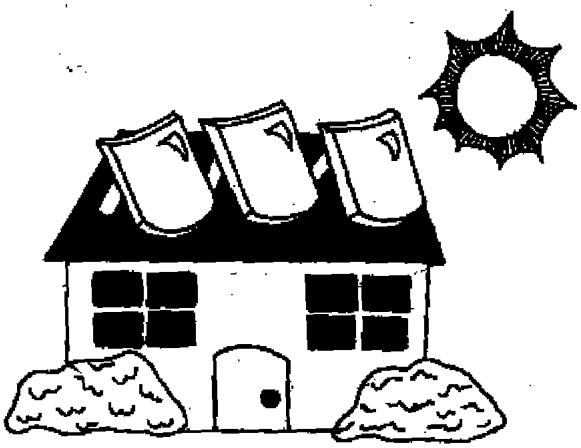
Grid System - An interconnected system of electric cables and power stations that distribute electricity over a large area.

World Resources Institute, World Resources 1994-95.

Solar Power

Sun rays warm the Earth,allow plants to grow and are necessary for all life. Energy from the sun can be used by humans in many ways without the use of any special equipment.

The sun's energy can be used to heat a greenhouse, because the glass traps the heat of the sun. Many buildings are designed with large windows facing the sun and small windows facing away from the sun to make the most of solar heat.



There are "high-tech" ways of using sun rays. Photovoltaic cells change light energy directly into electricity. Solar collectors are black tubes that contain water; sun rays heat the tubes, which in turn heat the water. Hot water can be used to heat a house, or for other purposes.

Photovoltaic (PV) cells have proven to be highly successful in the developing world. As well, since PV cells do not have to be hooked up to power lines,they can provide electricity to villages or small towns. This is a real advantage because many rural settlements in the developing world have never been able to receive electricity before.

Solar power produces no greenhouse gases or air pollution. It is a renewable, free energy source that will last forever. In one day, the amount of solar energy streaming towards the Earth equals the energy produced by burning 550 billion tonnes of coal!

One of the greatest problems with solar electricity is how to store the energy. Today's batteries are too inefficient at storing power, and in order to produce large quantities of electricity, large areas of land are required for solar panels. Also, photovoltaic cells are expensive to build.

Solar power is still not practical as an energy source for cars and buses.

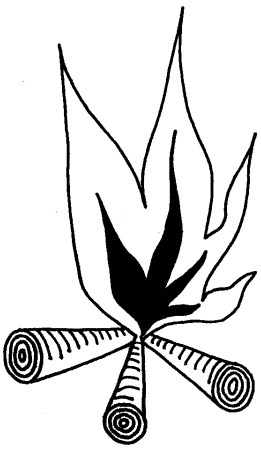
World Resources Institute, World Resources 1994-95.
Brown, Lester (ed.), State of the World 1993. Worldwatch Institute.

Biomass Power

Biomass energy comes from burning any type of vegetation or animal waste (e.g. cow dung). Basic heat energy can be obtained from biomass sources. For tens of thousands of years, people have used a wood fire for warmth and cooking. Biomass energy is only renewable if people continue to replant the vegetation that they burn.

Biomass energy is still the principal source of energy for most people in the developing world. For example, 75 percent of all household energy in Africa is derived from biomass material.

Mainly the biomass collected is wood,and most of it is collected by women and children. They use this wood for fuel to heat their homes and cook their food. Sometimes people use animal dung or crop residue (leftover scraps once crops have been gathered) as fuel.



Unfortunately, the present method of using fuel wood is inefficient. Often women and children spend more than three hours a day travelling long distances to search for fuel wood.The trouble is that most of the forests or woody areas where these women usually go have either been depleted for fuel wood, or burned down to create agricultural fields.This means that women and children have to travel much farther to find enough fuel wood for their families.

As well, burning wood or dung in traditional stoves pollutes the air in rural kitchens, and using dung for fuel deprives the soil of nutrients needed for agriculture.

Engineers and scientists are trying to invent new ways to convert biomass to energy. For instance, they are trying to discover ways to use biomass energy to create electricity, to generate heat for industry or to convert it to a gas that is suitable for cooking or driving a car.

One plan is to directly convert biomass to fuel, such as ethanol and methanol. At the moment, the easiest way to generate liquid fuel from biomass is by converting sugar canes into ethanol through the process of fermentation (the breakdown of sugars by yeast). Biomass-generated fuel can be mixed with petroleum-based fuel in the transportation sector. Therefore, less petroleum would be used.

The only renewable way to use biomass energy on a large scale would be to replant deforested land with forest-biomass plantations.

World Resources Institute, World Resources 1994-95.
Brown, Lester (ed.), State of the World 1993. Worldwatch Institute.

TV Persuasion

Lesson 15

Summary: Students critically view television advertisements and analyze the persuasive techniques used.

Length: Two 45 minute periods (they do not have to be consecutive).

Outcomes: The student will:
1. interpret four persuasive techniques used in advertising;
2. design their own two minute persuasive commercial on a renewable energy source.

Background: This activity introduces to students how TV advertisers try to convince them to buy a product. This lesson is further reinforced when students employ a persuasive technique in designing their own ad.

Before the class, video tape at least three TV commercials that clearly show one of the four persuasive techniques explained in Step #7 of the Procedure.

Materials: Three commercials taped from TV, video machine, TV, and video camera (optional).

Procedure:

1. Without explanation, show three TV commercials.
2. Explain that you will replay the first ad, but this time ask students "What does the advertiser want us to do?" (i.e. what is the ad's objective?).
3. Replay the first commercial.
4. On the board give the commercial a title and write down what the class thought the objective of each commercial was (i.e. to sell a product, to raise awareness of an issue like the ill-effects of smoking, to promote an event like the Olympics, to advertise a tourist vacation spot, to announce a political message like resistance to education cuts).
5. After the objectives are recorded, ask what techniques the advertiser used to get their point across.
6. If time permits, repeat the process for the other two commercials.
7. During the discussion, students may mention one of the following four techniques (if they do, write the name on the board):

   ❶ **Bandwagon:** Persuading people to do something because others are doing it (e.g. "6001 people switched back to Bell this week", "Drink Milk, Love Life").

   ❷ **Testimonial:** The commercial features a famous person to persuade you to buy their product (e.g. Candice Bergen for Sprint Canada, Michael Jordan for Nike).

   ❸ **Repetition:** The product name is repeated at least four times, or the commercial contains a memorable jingle, e.g. (McDonald's – "Have you had your break today?...", "Always Coca-Cola").

   ❹ **Emotional:** Advertisers get you emotionally involved in the commercial (e.g. Bank of Montreal and Saturn cars).

8. Ask students to write down the definitions and to list some examples of each that they remember from watching on television.

9. Students split into their five "energy source" groups to design a commercial to promote their energy source. Students may employ more than one technique in their ad. Each group's presentation should run a maximum of two minutes, otherwise no other instructions should be included unless the students ask.

Closure: Students should sign up for any A/V equipment they will need for their presentations next class.

Extension: As another lesson, students create a display/poster of their energy source using the same four persuasive techniques. The goal is to convince others that their source is the best option for generating energy in Ontario. Their arguments should be based on social, environmental and economic perspectives.

Source:

Adapted from "Propaganda Techniques" by L. Tanaka.

On With the Show

Lesson 16

Summary: Students present their advertisement for their energy source.

Length: 60 minutes.

Outcomes: The student will:
1. perform a two minute presentation to the class using props;
2. recognize bias in presentations and critically evaluate their classmates;
3. state three advantages and three disadvantages of five energy sources.

Background: As the culminating lesson to Chapter four, students perform their energy source commercials. Discuss how a 'slick' sales pitch can persuade the public regardless of the facts. Therefore remind students never to trust any ads until they have done their own research. If your school has a camcorder, videotape the presentations for use at open houses

Materials: Camcorder (optional), any A/V equipment that students request, bristol board with five 8.5" x 11" spaces for students to post completed HANDOUT 14-A, HANDOUT 16-A (Evaluation Sheet, photocopy this sheet onto double-sided paper so each student only needs one page to evaluate all the presentations).

Procedure:
1. Each group is given a maximum of two minutes to present their advertisement on their energy source.
2. Class members evaluate the presentation using the evaluation provided (HANDOUT 16-A).
3. Afterwards, the class critiques the presentation.
4. The group states, in plain language, three advantages and three disadvantages of their energy source.
5. Students explain how they attempted to highlight the positives and downplay the negatives of their energy source in the commercial's sales pitch.
6. After all the presentations are completed, discuss with the class how advertising in the media tries to convince people one view while the reality may be very different.
7. Students post HANDOUT 14-A on a bulletin board display provided by the teacher.

Closure: Collect completed peer evaluation forms.

Extension: If you used a camcorder, consider videotaping the presentations to provide the students with feedback on their performances as another critiquing exercise.

Chapter Four: **HANDOUT 16-A**

"On With the Show" Peer Evaluation Forms

After each TV ad is presented,fill out this evaluation for the entire group. Next to each question, circle the number which best represents the quality of this group's work. Five is the highest mark and one is the lowest mark a group can receive.

Energy Group: ________________		**Poor**		**Fair**		**Excellent**
1.	**Volume and clarity of speech?** *(could you hear them?)*	❶	❷	❸	❹	❺
2.	**Creativity and originality?**	❶	❷	❸	❹	❺
3.	**Production effort?** *(used interesting props, etc.)*	❶	❷	❸	❹	❺
4.	**Effective communication of the information?**	❶	❷	❸	❹	❺
5.	**Overall impressions?**	❶	❷	❸	❹	❺

……

Energy Group: ________________		**Poor**		**Fair**		**Excellent**
1.	**Volume and clarity of speech?** *(could you hear them?)*	❶	❷	❸	❹	❺
2.	**Creativity and originality?**	❶	❷	❸	❹	❺
3.	**Production effort?** *(used interesting props, etc.)*	❶	❷	❸	❹	❺
4.	**Effective communication of the information?**	❶	❷	❸	❹	❺
5.	**Overall impressions?**	❶	❷	❸	❹	❺

……

Energy Group: ________________		**Poor**		**Fair**		**Excellent**
1.	**Volume and clarity of speech?** *(could you hear them?)*	❶	❷	❸	❹	❺
2.	**Creativity and originality?**	❶	❷	❸	❹	❺
3.	**Production effort?** *(used interesting props, etc.)*	❶	❷	❸	❹	❺
4.	**Effective communication of the information?**	❶	❷	❸	❹	❺
5.	**Overall impressions?**	❶	❷	❸	❹	❺

Chapter Five Overview: **Consensus Building**

Lesson 17 **Roundtable Discussion**

- Students use a consensus building technique to discuss an issue associated with climate change.

Chapter Outcomes: The student will:

1. recognize environmental issues are connected to economic, political and social issues;
2. explain how the "roundtable" method of consensus building attempts to solve problems;
3. reach a consensus position based on negotiation;
4. work cooperatively in a group.

Roundtable Discussion

Lesson 17

Summary: Students choose a possible solution to climate change and engage in a roundtable discussion to reach a consensus.

Length: Two class periods (one period to prepare and one period for the roundtable discussion).

Outcomes: The student will:
1. recognize environmental issues are connected to economic, political and social issues;
2. explain how the "roundtable" method of consensus-building attempts to solve problems;
3. reach a consensus position based on negotiation;
4. work cooperatively in a group.

Background: A roundtable discussion attempts to create a consensus position between several parties.As opposed to a debate, the roundtable process does not declare winners and losers, but attempts to reach a position acceptable to all the parties with the aid of a neutral facilitator. You will find a complete scenario set up for you at the end of the lesson. There are five stages to the process:

1. Select an issue.
2. Determine the Interest Groups: the parties (i.e. governments,citizens, businesses, etc.) that are affected by the issue.
3. Interest Groups present their position.
4. Negotiate to find consensus.
5. Discuss the process.

Since a roundtable method will be a new concept to the students, it may take some adjusting. It requires the class to work with the utmost **cooperation** and **respect** for others and their opinions. Students must get used to discussions in which no one is right or wrong. Review with students that this is not an 'open fight', but an **'open discussion'** . Ban such phrases as "you're wrong, that's a stupid idea, etc." Instead ask the class to say "I don't agree with your idea because..." when they reply to someone. Spend time explaining a **consensus** and how to go about reaching it. Emphasize that **compromise** is essential: all interest groups have to be willing to **settle** and to give up some of their demands when trying to reach a consensus.

The role of the facilitator is key in a successful roundtable. The facilitator has to listen carefully, take note of each party's concerns,and move the group towards consensus by focusing on the points that people seem to agree on and letting go of others that present conflict.The teacher should act as the facilitator to keep the discussion on track, at least until the students are familiar with the process (see Extension activity).

Materials: The five stages of the roundtable discussion printed on primary chart paper (see background).

Procedure:

1. Brainstorm or review broad solutions to climate change that may have been covered in previous lessons. These may include:
   - driving slower, and accelerating from a stop gradually

- discouraging people from driving their cars
- switching to renewable sources of energy
- encouraging greater use of public transit and bicycles
- improving automobile fuel efficiency

2. For each solution, point out who must be involved to ensure the success of the solution. For example, increasing the use of fuel-efficient cars would likely require the participation of car manufacturers, engineers,auto sales companies, government, environmental groups, and drivers.

3. Explain that the class will use a method called a "roundtable discussion" to discuss an issue related to climate change. Point out the five stages of the roundtable discussion and explain the terms "interest groups" (an organization, business,or government directly involved in or affected by a problem or issue) and "consensus" (when everyone agrees to something). For instance, the class may reach consensus that summer holidays are not long enough, and perhaps the staff would agree as well.

4. Have the class choose one of the solutions to climate change that has been discussed and brainstorm some of the practical ways that this solution could be implemented.*

   Example: If the solution is to discourage driving and encourage the use of public transit, students might come up with the following practical ways to accomplish this:

   - increase parking fees in downtown areas
   - require drivers to purchase transit passes as a means of funding local transit
   - increase license plate fees
   - increase funding to the local transit authority
   - reduce fares on local transit

* *See the end of this lesson for a complete scenario on renewable energy sources.*

5. Decide on the groups who would be most affected by these measures and divide the class into interest groups accordingly. For instance, in the example suggested above, the interest groups might be the local transit authority, an environmental group, downtown business owners, drivers who live in out-lying suburbs.

6. Ask the interest groups to brainstorm their position on the issue in preparation for presenting it to the class. They need to decide on at least one concern about the proposed solution and one action that should be taken.

7. Seat the four groups so they can see one another; for instance, place desks in a large horse-shoe with one end open at the front of the class to give the facilitator room to stand and write.

8. Ask each group to present a two minute summary of their positions. The summaries should include both their concerns and the actions that they think need to be taken. The group may elect a spokesperson, but after the first summary, the facilitator may call on any one in the group to speak so that each student participates in the roundtable discussion.

9. The facilitator takes notes on each groups' main concerns (i.e. saving money, health, climate change, etc). Afterwards, the facilitator leads the group through each item on the list until a consensus is reached on what steps to take. Remind groups that they are going to have to make 'trade-offs' by letting go of some concerns or agreeing to others in order to reach a consensus.

10. The facilitator attempts to find a common ground among all positions: "Are we agreed that.....". Cross out concerns and actions that are controversial. Try to get the class to agree on a few key points. Each group has to agree to at least one concern or action in order to get to the consensus level (the ideal would be to get the class to agree on what actions need to be taken to resolve this problem).

11. At the end of the negotiation, the facilitator and the groups attempt to compose a consensus statement.

Closure: After a consensus is reached or time runs out,conduct a large group discussion on the process:

- ➢ Does the roundtable model work? Why? Why not?
- ➢ How could it break down?
- ➢ How could it be improved?
- ➢ Is this a good way to make decisions?

Extension: Try the jigsaw method in which each student has the opportunity to represent an interest group. In this variation, steps 1-6 of the procedure remain the same. Students are first divided into interest groups where they brainstorm their position and become "expert" representatives of their group's point of view. While the interest groups are meeting, the teacher can meet with a group of volunteer or appointed student facilitators to review their roles and responsibilities. Roundtable discussions are then held,with each roundtable group including one "expert" from each "interest group". It will be interesting to compare the different consensus agreements reached in the small groups. This extension works best if students,especially younger students have participated in at least one roundtable discussion with the teacher as facilitator.

Scenario: The following scenario includes the first three stages of the roundtable process. It will help you to carry out Procedure #4-6. The table on the following page includes suggestions to help guide students while they form their interest group's positions. They are merely suggestions - the main thing is to see if students can come up with their own ideas. All you have to do now is lead the discussion!

1. **The Issue:**
   Nuclear power plants in Ontario are coming to the end of their life-time. In 1996,they provided 66% of Ontario's energy. Ontario Hydro, the province's electric utility, is being forced to look for alternatives to nuclear power that are environmentally safe and renewable. They must decide whether to invest in more renewable energy sources like wind, hydro and solar energy (aka green power).

   (see following page)

The Interest Groups and Their Positions:

The Concerned Residents Group	**Concerns:** Never felt comfortable about nuclear power in the first place; • willing to pay a little more on their energy bills for green power, but not too much; • concerned about the reliability of renewable energy sources. **Action:** Willing to compromise by agreeing to slowly implement new sources.
Industry Representatives	**Concerns:** Want cheap electricity, who cares if we use renewable and environmentally-friendly sources?; • scared of falling profits and losing jobs. **Action:** Want government to subsidize companies' energy bills.
Ontario Ministry of Energy	**Concerns:** Committed to reducing greenhouse emissions in the province by 20% by the year 2005; • concerned about the costs of introducing these sources (who will fund it?). **Action:** If it's not too expensive, the government will support green power.
Ontario Hydro Board of Directors	**Concerns:** Want to be known as leading electricity supplier; • renewable energy is the way of the future; • renewable sources are sustainable. **Action:** Go ahead and replace nuclear power with renewable power.
Toronto Healthy City Office	**Concerns:** Trying to protect peoples' health; • nuclear power is not safe; need to switch to other sources; • burning coal is also damaging to people, particularly since it contributes to smog. **Action:** Ontario Hydro should completely switch over to renewable sources.

Chapter Six Overview: **Climate Change Around the World**

Lesson 18 **World Tour**

- Students learn of greenhouse gas reduction initiatives throughout the world,in learning centres.

Lesson 19 **Transitville**

- Students design a public transportation-oriented city.

Chapter Outcomes: The student will:

1. Identify cities on a world map that are taking steps toward greenhouse gas reductions;
2. Summarize the steps that each city is taking;
3. Rank the 12 highest polluting countries by total greenhouse gas emissions and per capita greenhouse gas emissions;
4. Compare the difference between total emissions and per capita emissions;
5. Apply the skills learned during this unit to design a transit-oriented community;
6. Cooperate and compromise to make decisions within a planning group;
7. Rationalize the completed plan to the class.

WorldTour

Lesson 18

Summary: In learning groups, students perform two global climate change activities. In activity #1,students locate cities on a world map and describe their greenhouse gas reduction initiatives. In activity #2, students rank the 12 highest greenhouse gas producing countries by total and per capita emissions, and label them on a map. An extra activity sheet is included.

Length: 60 minutes.

Outcomes: The student will:

1. identify international cities on a world map that are taking steps toward greenhouse gas reductions;
2. summarize the steps that each city is taking;
3. rank the 12 highest polluting countries by total greenhouse gas emissions and per capita greenhouse gas emissions;
4. compare the difference between total emissions and per capita emissions.

Background: Climate change is a global phenomenon. Even if there are major differences between the amount of greenhouse gases that each country emits, everyone is going to suffer the consequences sooner or later. Therefore, we all need to clean up our act. Students should appreciate that cities world-wide need to address climate change in order to effectively solve the problem.

This lesson also emphasizes the difference between *total greenhouse gas emissions* and *per capita greenhouse gas emissions.* Some countries might have very high total emissions, but with a large population, they appear very low on the per capita scale. A country like Canada, on the other hand,has high total emissions, and with a relatively small population is only second to the USA in per capita emissions. This means that every person in Canada uses a lot more energy (greenhouse gases are produced when we consume energy), than a person in let's say, India.

Materials: HANDOUTs 18-A (Thinking Globally, Acting Locally), 18-B (World Map - 3 copies for each student), 18-C (Who are the Real Dirty Dozen?),18-D (Categories Conundrum), 10-15 atlases, pencil crayons.

Procedure:

1. In order to save time, arrange desks into small learning centres (groups of four) and have the four HANDOUTS and the rest of the materials on the desks before students arrive.
2. Divide the class into groups.
3. Make your instructions brief, the activities are fairly self-explanatory. Consider writing short instruction cards for the two activities. You can copy the instructions below:

   ❶ "What's Going On?"

   - Read about greenhouse gas reduction initiatives around the world and highlight key points (HANDOUT 18-A).
   - On a world map (HANDOUT 18-B), locate the cities and write in the city and country's name (you can use atlases to help you).
   - Summarize the initiatives in point form on the second page of HANDOUT 18-A).

4. After 25 minutes, start students on the second activity:

   ❷ "Who are the Real Dirty Dozen?"

   - Rank the two lists from the highest to lowest greenhouse gas emitters using different colours according to their rank(HANDOUT 18-C).
   - On the two maps provided (HANDOUT 18-B), colour in the country according to their greenhouse gas production (one list per map).
   - Colour the largest producer red and the lowest producer green. You can choose the colours for the other countries. (Make the colours the same for each map).
   - Draw a colour legend on your map.

Closure: Allow 10-15 minutes for a closing discussion.

1. Discuss with students why it is necessary that countries all over the world need to reduce their greenhouse gases.
   - Go back to the system concept - if one part fails the whole system falls apart.
2. Discuss the differences between the two lists in Activity #2 – is one group worse than the other?
   - High per capita emissions are generally considered worse, because more greenhouse gases are emitted per person, meaning that these peoples lives are more luxurious than many others.
3. Look at the two maps from Activity #2, compare them. Where are the majority of the countries in each map?
   - More developed countries should be among the per capita list, whereas the total emissions list includes both developed and developing countries.
4. This could spark a discussion about population versus consumption levels. For instance, we will see a large increase in greenhouse gas emissions as more people can purchase cars, etc. What should be pointed out is that population growth is only half of the equation. Consumption (how much we use of the world's natural resources) levels should also be considered.
4. There is also a difference between 'survival' versus 'luxury' emissions. Humans need to produce some greenhouse gas emissions in order to live. For example, rice paddies grown in the developing world for local food supplies are not on the same level as the billions of cars that are driven every day all over the world. Try listing with the class different 'survival' and 'luxury' emissions.

The bottom line is if everyone in the world shared the living standards of North Americans, the resources would be depleted even faster than is currently happening. It is only possible to support a larger world population if we all reduce our consumption of the world's resources.

Extension: HANDOUT 18-D is a word puzzle in case students finish early, or may be used as a homework assignment.

Thinking Globally, Acting Locally

The following paragraphs are examples of what cities around the world are doing to help reduce climate change. Read each paragraph. Using an atlas, label the cities on the map provided. On the next page, summarize what each city is doing in two or three points.

Toronto, Canada

In 1990, Toronto pledged to reduce CO_2 emissions by 20 per cent by the year 2005. To meet its target, Toronto will make sure that new buildings are energy efficient. Before construction begins, developers must submit an energy efficiency plan. Existing buildings are also being made more efficient.

Lahore, Pakistan

This city has constructed a power station fuelled by methane gas collected from a landfill site. This greenhouse gas, which is released from decomposing garbage, would otherwise be released into the atmosphere.

Saarbruecken, Germany

The city started a program which uses solar energy to heat outdoor pools. The system saves 265 tonnes of CO_2 emissions each year.

Singapore

Under the Area Licensing Scheme (ALS), vehicle owners have to pay a fee to drive in the downtown area during rush hours. Police check the license cards of vehicles and fine illegal ones. Motorized traffic has dropped by 50 per cent after the introduction of the program.

Portland, United States

Portland hopes that transit oriented developments (TOD's) will reduce greenhouse gas emissions by reducing car traffic. In a TOD community, shops, offices, parks and other public areas are located close to public transit. The aim is to design a community where people can walk, cycle or take public transit instead of driving a car.

Ankara, Turkey

To help improve the air quality of the city and to help reduce the city's emissions of CO_2, the city started a Fuel Switching Program. The city converted 170,000 households from inefficient coal stoves to natural gas. As a result of the conversion, emissions of CO_2 and N_2O (nitrous oxide) from the households have been reduced by 50 per cent.

Thinking Globally, Acting Locally

Toronto, Canada _____

_____

_____

_____

Lahore, Pakistan _____

_____

_____

_____

Saarbruecken, Germany _____

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Singapore _____

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Portland, United States _____

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Ankara, Turkey _____

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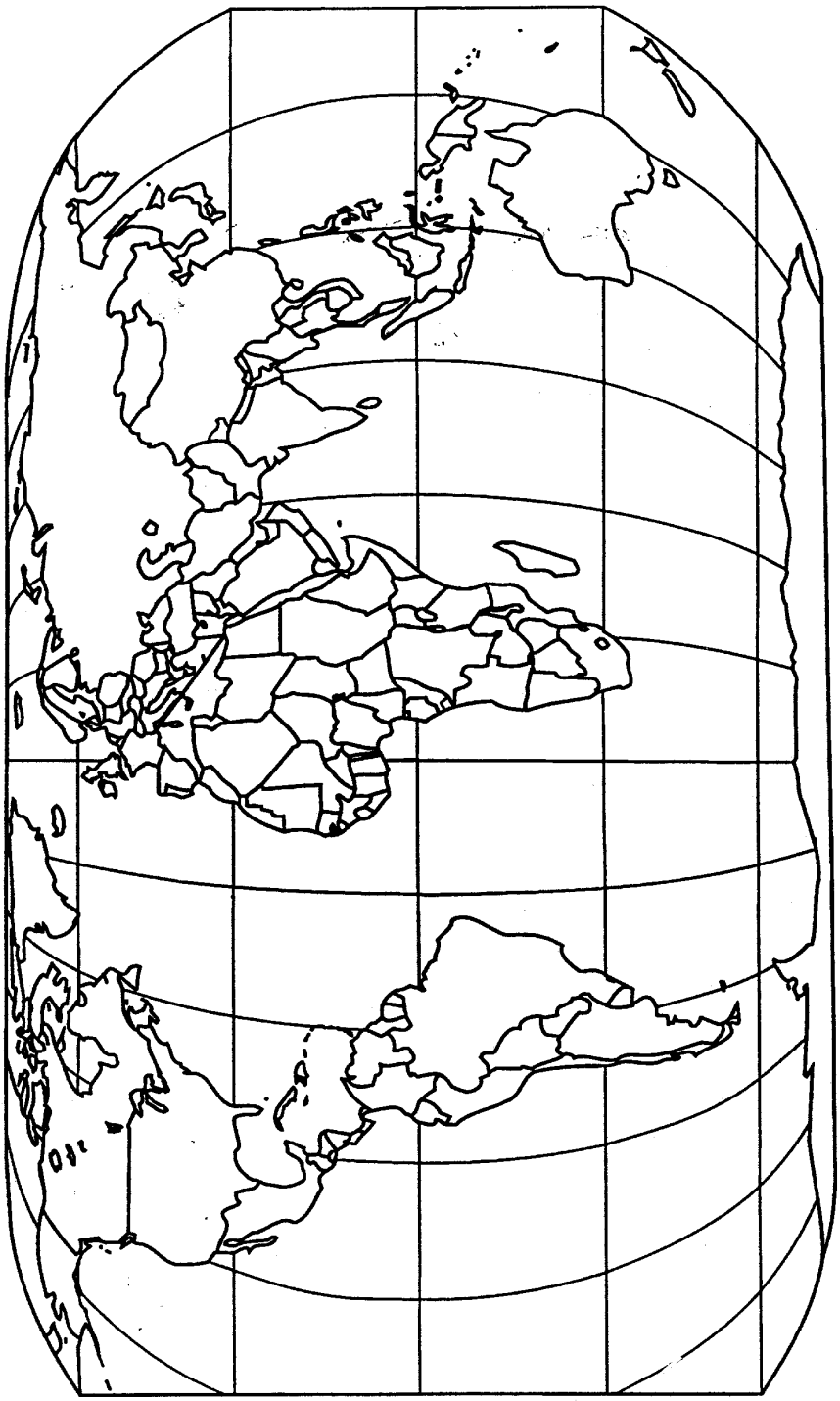
World Base Map



Who are the Real Dirty Dozen?

Name: _____

Below you will find two lists of the 12 countries with the highest total greenhouse gas emissions and per capita* greenhouse gas emissions, based on data from 1990. The greenhouse gas emissions are shown in metric tonnes of carbon.On page two, rank the countries from 1-12 using a different colour for each. When you have finished,use an atlas to locate and label all of the countries in the different colour you have chosen. Use one map for each list.

Total Emissions (Metric Tonnes)

China - 2,420,936,704

United Kingdom - 573,569,888

Germany - 974,426,144

Italy - 395,957,488

Former USSR - 3,711,555,056

Canada - 418,784,208

Brazil - 201,747,168

Japan - 1,079,901,712

United States - 4,934,605,584

India - 675,007,728

Mexico - 324,908,864

France - 354,026,672

Per Capita Emissions (Metric Tonnes)

Japan - 8.74

Australia - 15.55

Germany - 12.66

Singapore - 13.88

Canada - 15.72

Poland - 9.13

Former USSR - 12.83

United States - 19.74

United Kingdom - 9.99

Trinidad and Tobago - 2.58

Czechoslovakia - 13.47

Norway - 12.32

* Per capita means the amount of greenhouse gases that is emitted **per person** in a country.

Who are the Real Dirty Dozen?

Name: _____

Rank	**Total** (country and emissions)	**Colour**	**Per Capital** (country and emissions)
1		Red	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12		Green	

Categories Conundrum!!

	Energy Sources	Modes of Transportation	European Cities	Countries
C	coal	car canoe camel carriage catapult	Castlebar, IRE Chernobyl, UKR Cologne, GER Coppenhagen, D Cork, IRE	Cambodia, Canada, Chad Chile, Colombia, Costa Rica, Croatia, Cuba, Czech Republic
F	fossil fuel	flying ferry fire truck frigate felucca	Fier, ALBANIA Florence, ITALY Frankfurt, GER	Falkland Islands, Fiji, Finland, France, French Guiana, French Polynesia
G	gas	glider gondola go-cart	Galway, IRE Geneva, SWITZ Genoa, ITALY Granada, SPAIN Grenoble, FRA	Gambia, Germany, Great Britain, Greece, Greenland, Guatemala, Guinea, Guyana
P	propane	pogo stick plane parachute police car phaeton	Paris, FRANCE Prague, CZECH Palma, SPAIN Pori, FINLAND Pozman, POL	Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland Portugal, Puerto Rico
S	solar power	sailboat skateboard ski skipping	Salzburg, AUS Sarajevo, BOS Sofia, BULG Stockholm, SWE Stuttgart, GER	Saudi Arabia, Senegal, Seychelles, Singapore, Slovenia, Somalia, South Africa, Spain, Sweden, Switzerland
T	wind turbines	train tram truck	Tilburg, NETH Toulouse, FRA Triesen, LIECHT Turin, ITALY Turku, FIN	Tahiti, Taiwan, Tanzania, Thailand, Tonga, Trinidad & Tobago, Turkey

Categories Conundrum!!

For each of the categories listed, can you think of a word beginning with each letter on the left? Count one point for each correct answer. A score of 21 and above is amazing and a score of 16 and above is well done. You may use an atlas for the last two categories.

	Energy Sources	**Modes of Transportation**	**European Cities**	**Countries**
C				
F				
G				
P				
S				
T				

Transitville

Summary: In small groups,students design a public transportation-oriented community.

Length: 45 minutes.

Outline: The student will:
1. apply their skills learned during this unit to design a transit-orientated community;
2. cooperate and compromise to make decisions within their planning group;
3. explain the completed plan to the class.

Background: The Transitville lesson is the last lesson of this unit. It is a culminating lesson in that it draws upon all the skills that students have learned throughout this unit to take action against climate change to plan a 'greenhouse friendly', public transit-oriented city.

These students are going to be our future planners,policy-makers, engineers, and homeowners. Hopefully we can educate them about what a sustainable city should look like. We need to redesign our 'sprawling' cities.

Materials: HANDOUTs 19-A (Transitville instructions), 19-B (Transitville map);Transitville cards (photocopy and cut out the cards before class), pencil crayons, glue.

Procedure:

1. Explain today's activity. Ask students what is important to remember when planning a transit-friendly community.
   - Everything needs to be closer together.
   - Everything needs to be especially close to transit.
   - Homes, shopping,and work places should be mixed together so homes aren't so far away from work places and shopping, etc.

   The following concepts will likely be new to students; you can turn these facts into questions during the discussion:

   - In order to make this community sustainable (make it last), there needs to be more people living in it so that many people will use the public transit. Otherwise, it will be too expensive to operate. This is known as 'high density'.
   - Apartment buildings increase the density in an area, since more people live in one place.
   - Small homes are also better than large homes, because they take up less space.
   - If we can all live in high density areas and minimize our space, then we won't have to go and build on 'untouched' land.
2. Now break the class up into groups of 2-4 students to plan their own 'Transitville'.
3. Provide each group with HANDOUT 19-A (instructions), 19-B (map) and the cards representing homes, stores, a park,a school and work areas.
4. Let the students design their own city around public transit,and then glue the cards down when they are happy with their design.

Closure: When everyone is finished, regroup and have each group present their plan and rationale.

Extension: Students can create a crossword for their classmates using ecological and climate change terms learned in this unit. Tell them their puzzle should have at least three words up and three words down. Students can do this alone or in pairs. They may also use the "Neat O Facts" handout found in the APPENDIX for their clues. Find out if your school has a computer program like "Crossword Magic" where you can create and format your crossword on computer.

Students can collectively design a web page to educate others about climate change and its effects on the Earth, and/or a class mural to hang in the school.

Transitville, Ont.

Read the following carefully before starting the activity:

The city planning department has hired your company to design a new community. They want you to follow the lead of Portland, Oregon which is using "Transit Oriented Designs" (TODs). In this community, people should be close to public transit so they do not need to drive. Therefore, in this new community, less greenhouse gases will be emitted from car traffic.

In the new community of Transitville, the subway has already been built. It consists of a **North-South line** and an **East-West line** . There will be eight subway stations in total, two of them will be transfer stations. You are asked to decide where these stations should be built.

Procedure:

1. In your group, place the park, shopping, work and home markers wherever you decide makes the most sense. Keep in mind that houses should be close to shopping and work offices,and that many people use the park each day from all over the community.

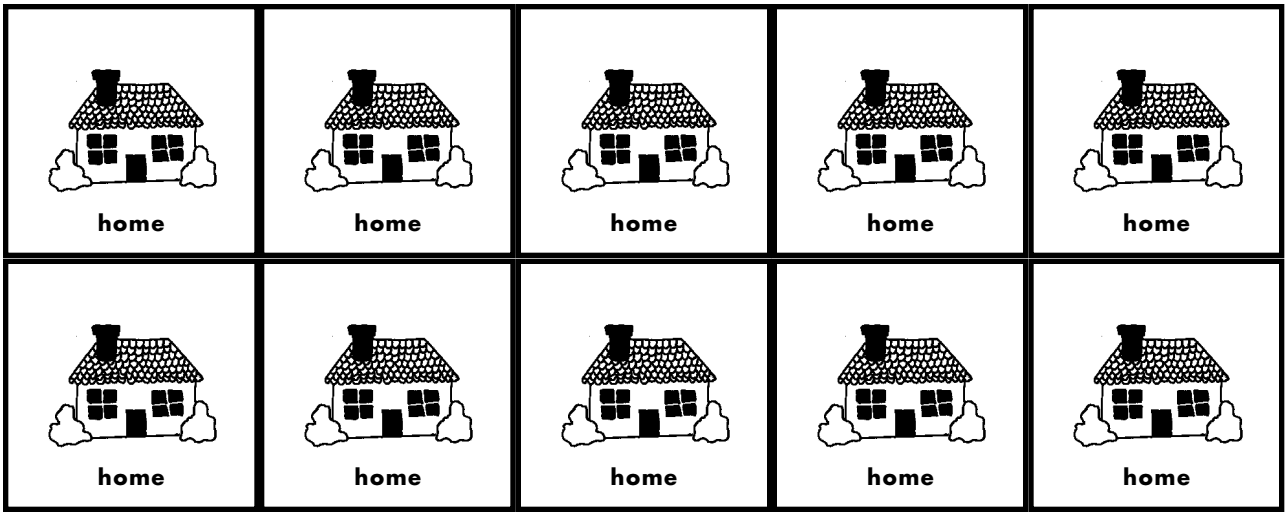
2. When placing your home markers,decide whether there should be more single homes or apartment buildings.

3. Decide where to put the subway stations. Your budget only allows for a total of eight stations for both lines. Keep in mind people will need to transfer from one line to another. Circle where the stations would go. Make a double ring circle for the two transfer stations.

4. Once your group agrees on the community, glue the markers into place, and include everyone's name on the map.

5. If you still have time, colour in your map. You may draw in some more trees and shrubs around the community.

Transitville Map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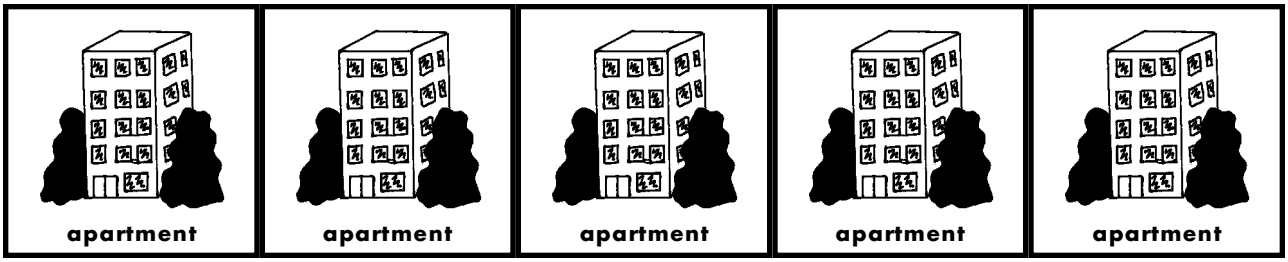
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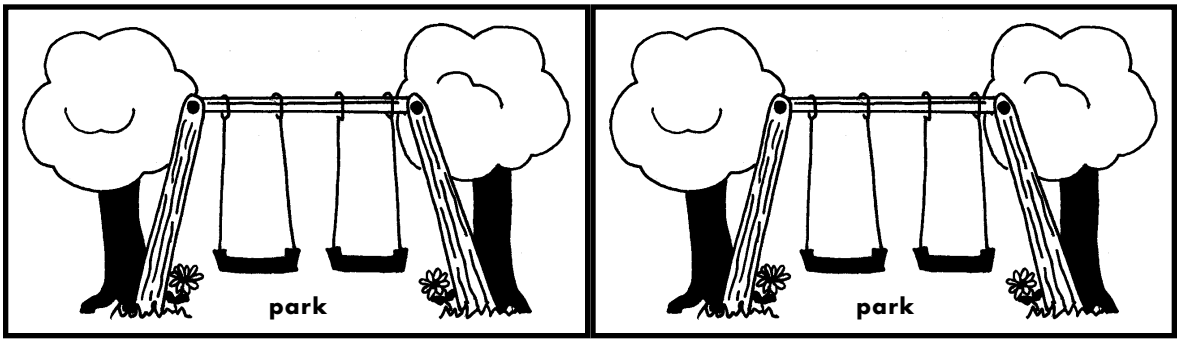
park
park

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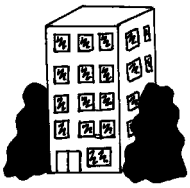
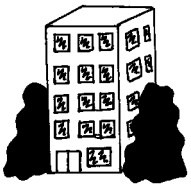
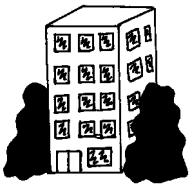
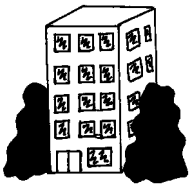
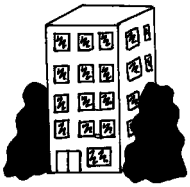
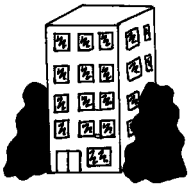
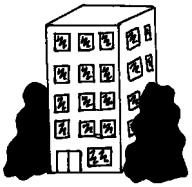
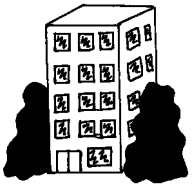
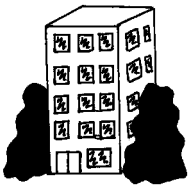
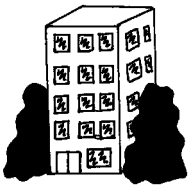
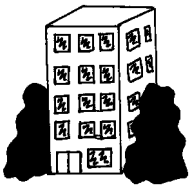
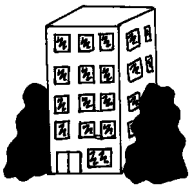
 **apartment**	 **apartment**	 **apartment**	 **apartment**
 **apartment**	 **apartment**	 **apartment**	 **apartment**
 **apartment**	 **apartment**	 **apartment**	 **apartment**

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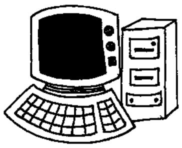

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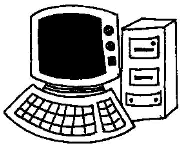

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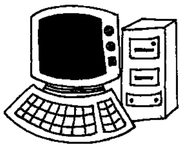

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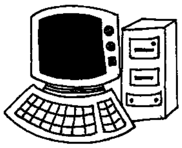

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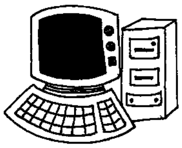

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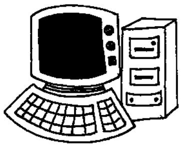

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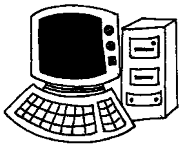

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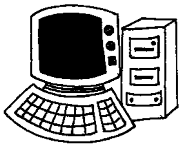

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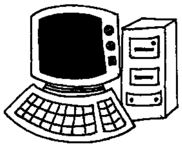

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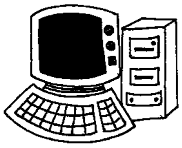

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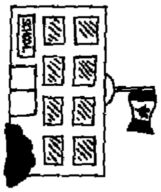

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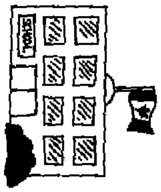

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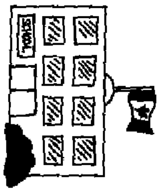

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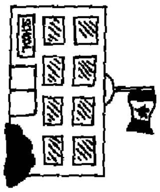

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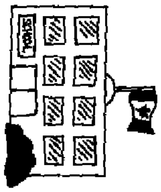

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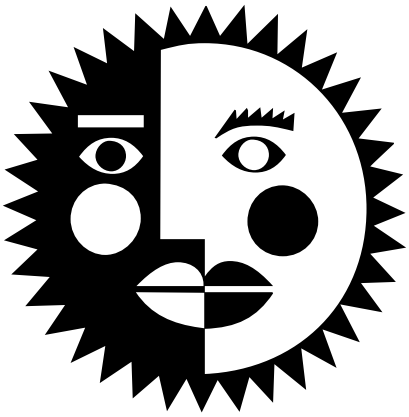
PART THREE



Glossary

Atmosphere - A mixture of gases and particles that surround the planet. It provides us with the air we breathe, its gases retain the heat that warms the Earth,and its protective layer of ozone shields us from damaging rays emitted by the sun. The atmosphere extends a few hundred kilometres above the Earth's surface, and it is divided into different layers.

Biomass Energy - A renewable source of energy derived from burning vegetation or animal waste (e.g. cow dung). Using biomass energy can be as simple as building a log fire to heat a home or as complex as chemically transforming sugar canes into ethanol fuel to power vehicles.

Carbon Dioxide (CO_2) - A colourless, odourless, tasteless gas found naturally in the atmosphere. An excess build-up of carbon dioxide from human activities is the main contributor to the intensified greenhouse effect in the atmosphere.

CFCs (chlorofluorocarbons) - Human-made gases that are responsible for much of the destruction of the ozone layer. CFCs are also excellent at trapping heat. CFCs were once widely used as propellants for aerosol spray cans, but they have been replaced by hydrochlorofluorocarbons (HCFCs). They are still used as coolers in refrigerators and air conditioners,present in industrial solvents, and are used in manufacturing foam products.

Climate - The long-term, average weather conditions in a region, including temperature, precipitation, wind patterns,cloud cover, etc.

Climate Change - The change in the average weather that a given region experiences. Different areas of the globe will experience different changes, like higher or lower temperatures, increased rainfall, more storm activity or extended drought periods. Global climate change refers to changes in all the interconnected weather elements of the Earth.

Conservation - The use of natural resources, such as fossil fuels and forests, in a way that enables future generations to benefit from the same quality and quantity of resources as past generations.

Decompose - The biological process in which microorganisms break down dead plant and animal matter into smaller parts or elements.

Developed World - Nations that already experienced industrialization at the beginning of the twentieth century. Generally, people living in the developed world enjoy a higher standard of living, and as a result consume energy at very high rates. Developed nations are concentrated in North America and Europe, and include Australia and New Zealand.

Developing World - Nations in the process of industrializing. The standard of living for the average person living in the developing world is usually low. Developing nations are mainly found throughout Africa, Central and South America, and some parts of Asia.

Ecology - The study of the interrelationships among animals, plants and their environment.

Ecosystem - A community of plants, animals and other organisms and the habitat in which they live and interact with one another.

Electrical Appliances - Devices designed for household use like refrigerators,microwaves and vacuum cleaners.

Emission - Gases discharged into the air; e.g.from human industrial activity like a smokestack or a car engine.

Energy Efficiency - When electrical devices and industrial processes are designed in such a way that the minimum amount of energy is needed to do their jobs. For example, using fluorescent light bulbs instead of incandescent bulbs is more energy efficient.

Environment - The surroundings in which all plants, animals and humans live.

Energy - The power necessary for all living things to function. Energy can be as simple as food nourishment needed by humans, plants and animals for survival or as complex as large wind farms which convert wind energy into electricity.

Fluorescent light bulbs - A device which provides light by transmitting electricity through a mixture of gases.Fluorescent bulbs use less energy than incandescent bulbs to produce a similar amount of light.

Fossil Fuels - Coal, oil and natural gas buried deep in the earth as a result of the decomposition of ancient plants and animals that lived millions of years ago.

Generator - A machine used for converting mechanical energy into electricity.

Grid System - An interconnected system of electric cables and power stations that distributes electricity over a large area.

Global Warming - The increase in the Earth's average temperature as a result of an increase of greenhouse gases in the atmosphere.

Greenhouse Effect - A natural process that creates a balance between incoming sun rays entering the Earth's atmosphere that are trapped (absorbed) by greenhouse gases or reflected back into space. The natural greenhouse effect moderates the Earth's temperatures and allows life as we know it to exist (see intensified greenhouse effect).

Greenhouse Gases - Any of the gases that contribute to the greenhouse effect by trapping heat within the atmosphere, including carbon dioxide (CO_2), methane (CH_4),nitrous oxide (N_2O),ozone (O_3) and CFCs.

Hydroelectric Energy - The generation of electric power from moving water, such as rushing water at dams and waterfalls.

Incandescent light bulbs - A device which generates light by transmitting electricity though a thin strip of metal, super-heating it so that it glows.

Intensified Greenhouse Effect - As concentrations of human-made greenhouse gases increase, the natural greenhouse effect intensifies. With a thicker greenhouse gas layer encircling the Earth, temperatures will rise at an alarming rate.

Methane (CH_4) - The major component of natural gas, and a normal trace gas in the atmosphere. Methane is a major greenhouse gas and is released through many human activities, e.g. through landfill waste, cattle ranches, rice paddies,and incomplete combustion of natural gas. Methane occurs naturally when plant and animal matter decompose.

Nitrous Oxide (N_2O) - A natural greenhouse gas that is also emitted into the atmosphere from human activities like burning wood,driving cars and the application of chemical fertilizers on crops.

Non-renewable Energy - An energy source that can be used only once and cannot be replenished. Coal is an example of a non-renewable energy source.

Nuclear Power - Nuclear power harnesses the heat energy created by splitting uranium atoms. The heat released is used to turn water into steam which is used to turn turbines and produce electricity. There is no known safe way to dispose of nuclear waste, which will be dangerous for thousands of years.

Ozone (O_3) - A highly reactive molecule of three oxygen atoms that is formed in the lower atmosphere when the sun's heat mixes with nitrogen oxides, hydrocarbons and other atmospheric pollutants. Ground level ozone is mainly an urban phenomenon where driving cars and industrial sites produce large amounts of air pollution. In the lower atmosphere, ozone can be harmful to living things, but it is necessary in the upper atmosphere to prevent harmful ultraviolet rays from reaching the Earth.

Ozone Layer - A thin layer of ozone found approximately 35 km above the Earth, which blocks the sun's harmful ultraviolet rays from reaching the Earth's atmosphere.

Photosynthesis - (photo = light, synthesis = create) A process in which the chlorophyll in plants convert carbon dioxide and water into oxygen and carbohydrates (sugars) in the presence of sunlight.

Pollution - The release by humans,directly or indirectly, of substances (including gases) into the environment, which results or is likely to result in damage to water, air or soil.

Power - A measurement of how much energy is used in a certain amount of time.

Precipitation - Rain,snow or dew that falls on the ground.

Renewable Energy Source - An energy source that can replace itself or be replaced. Sun, wind, and water are renewable energy sources. With the help of technological equipment to harness these sources, humans can use these natural phenomena for industrial, commercial and household energy purposes.

Respiration - The process by which humans and animals take in oxygen and expel carbon dioxide back into the atmosphere.

Retrofit - Remodelling a room or a building to make it energy-efficient by replacing energy-wasting appliances, improving insulation,etc.

Sinks - A process that removes greenhouse gases from the atmosphere, either by destroying them through chemical processes or storing them in some other form. Carbon dioxide is often stored in ocean water, plants or soils,from where it can be released at a later time.

Solar Energy - Energy obtained by converting the sun's energy into electricity or using it to heat water or air.

Smog - A haze found above cities in the summer when sunlight reacts with pollutants in the air. Smog makes it difficult for many people to breathe, causing many respiratory health problems.

System - An interconnected group of parts related or combined in such a way as to form a unified or complex whole.

Turbine - A machine with rotating blades that are turned by the flow of water or gas.

Weather - The condition of the lower atmosphere at a particular place and time, in terms of temperature, precipitation, wind patterns, cloud cover, air pressure, etc.

Appendix Overview: **Letter, Extension and Additional Activities**

Unit Test

- Final test questions that cover the entire unit.

Letter to Parent/Guardian

- Letter explaining the unit to parents and asking for volunteers for Lesson 9.

EXTENSION ACTIVITIES

Puzzle Cards

- Pictorial puzzle for the class to solve and find out the real identity of the Carl Von Dioxide Gang throughout Chapter Two.

Road Survey

- Lesson 9 Extension activity #1.

How Does Public Transit and Carpooling Save Space on Roads?

- Lesson 9 Extension activity #2.

Find the Energy Waste

- Lesson 13 Extension activity.

Light Patrol

- Lesson 13 Extension activity.

Home Energy Efficiency Tips

- List of suggestions for students' Energy Saving Action Plans in Lesson 13.
- Tips that can be sent home for parents and students to try together.

Lots O'Neato Facts About Climate Change

- Two pages of interesting climate change related facts for students to ponder.
- Can be used for the student crossword puzzle extension activity in Lesson 19.

ADDITIONAL ACTIVITIES

Colonel Draft Inspector and The Draft Stopper

- An activity that can be tried after students begin Chapter Three.
- A good activity for students who finish their work early.

Shut that Fridge Door!!

- A home activity to cut down on energy waste when using the refrigerator.

Writing Letters

- Students can get political by writing letters to their local and national government about climate change or other environmental issues that concern them.
- Government addresses provided.

Don't Stop ... There's Still More Action

- If you still haven't had enough, read these eight different action steps for students and teachers to do as extracurricular activities to reduce CO_2 emissions and make the school yard look more beautiful than ever.

Climate Change Unit Test

Here is a large sample of questions that can be used for a final test. The questions are divided by section. Choose the questions according to which lessons you covered in class. The marking scheme is just a guide - adapt it to suit your needs.

Chapter One

1. Describe the "Spaceship Earth" activity. (5 marks)
2. What is a system? Give an example in your explanation. (2 marks)
3. Draw and label a diagram of the greenhouse effect. (5 marks)
4. If the greenhouse effect is a natural process, why is it no longer working well? (2 marks)
5. Explain how the experiment using the foil and black paper simulated what happens on earth. (3 marks)
6. Name three greenhouse gases and give a source for each.(6 marks)
7. Describe three potential impacts of climate change in Canada. (3 marks)

Chapter Two

8. We conducted some research in our community. Describe the two activities and explain the results. (6 marks)
9. List three good and three bad environmental practices. (6 marks)
10. How do trees help reduce the greenhouse effect? (2 marks)
11. How much carbon dioxide can one medium sized tree absorb? (1 mark)
12. List three alternatives to driving a car. (3 marks)

Chapter Three

13. In the story *Times Have Changed*, why did the child of the past chop wood? (1 mark)
14. List four ways a child of today could reduce energy use. (4 marks)
15. How do using a clothes dryer and dishwasher contribute to climate change? (2 marks)
16. What are three things you can do for fun without using energy? (3 marks)

Chapter Four

17. What is a fossil fuel? (2 marks)
18. How do fossil fuels contribute to climate change? (1 mark)
19. Define *renewable energy source.* Give two examples. (3 marks)
20. For each energy source you listed above, give one disadvantage and one advantage. (4 marks)
21. Describe one type of persuasive technique used in commercials. (2 marks)

Chapter Five

22. Explain a roundtable discussion, how do you know if it is successful?. (5 marks)

Chapter Six

23. Name two cities that are taking steps to reduce their greenhouse gas emissions, and describe what they are doing. (4 marks)
24. What is the difference between 'total greenhouse gas emissions' and 'per capita greenhouse gas emissions'? (3 marks)
25. Canada has the second highest greenhouse gas emissions per capita. What does this mean for a typical Canadian? (3 marks)
26. What are two important points you learned while designing your 'Transitville' map? (2 marks)

Date: _____

Dear Parent/Guardian,

Our class is about to begin a new and exciting unit on global climate change (also known as global warming) called **Our Changing Climate** . We are going to be learning all sorts of fascinating things about the greenhouse effect,global carbon dioxide emissions, energy sources and energy use. The unit is designed to teach students to take an active role in helping to stop climate change. For instance, one of the activities will be to conduct a school-community audit to solve the question: Is our school atmospherically-friendly?

As part of this unit, we will learn about the different actions we can all take at school,at home and in the community at large to help our atmosphere. For example, the students will be designing personal "energy-saving action plans" where they will be asked to come up with three things that they can do to save energy at home. We need your cooperation as we start discussing these new ideas about how to save energy both in the home and by adapting our transportation habits. We would also appreciate as much reinforcement as you are willing to make in terms of performing the various actions at home. None of these actions are drastic; instead, they are small changes that you can make in your everyday lives. While you're at it, you may even save some money on your home energy bills!

We also need volunteers to help us conduct a Community Fieldwork Hike which will take about an hour. We need some extra eyes and ears while the students walk around the neighbourhood noting good and bad environmental practices. We will know the date of our fieldwork as we get further into the unit. For those parents who can participate, please send the attached note with your child by the end of the week.

If you feel that you do not have a good enough understanding of climate change to deal with the questions that your child might have or if you want some tips about how to be more energy efficient, please feel free to call me at school, and I will happily send you some background information.

Yours truly,

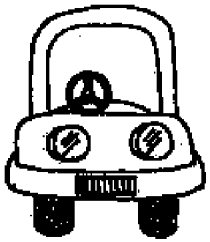
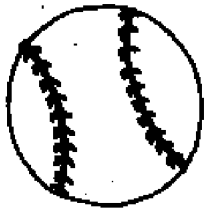
✂ .....

I,_____, parent/guardian of, _____ would like to volunteer on the class Community Hike that will last approximately an hour.

The best time for me would be: **Morning** ❒ **Afternoon** ❒

Phone # where I can be reached: _____
The best time to reach me is:_____

Appendix: **Chapter Two – Puzzle Card 1**

We  **- c the glo +** 

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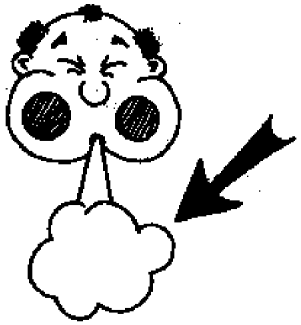
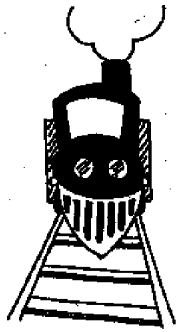
Appendix: **Chapter Two – Puzzle Card 2**

m +  **- b**

 **- tr**

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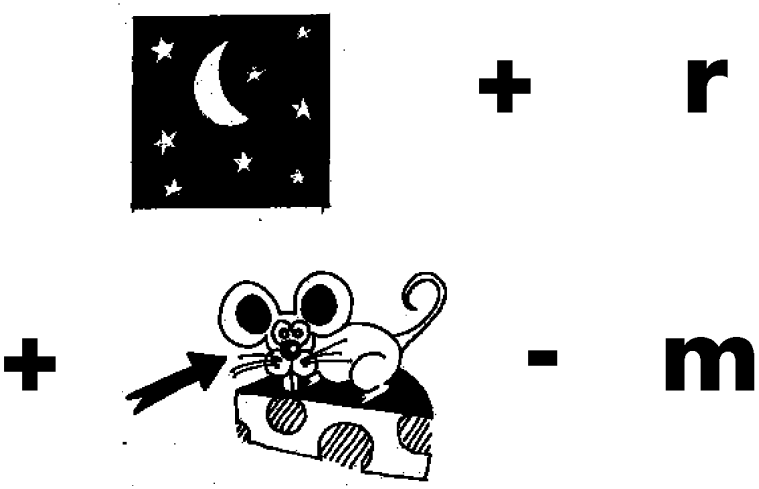

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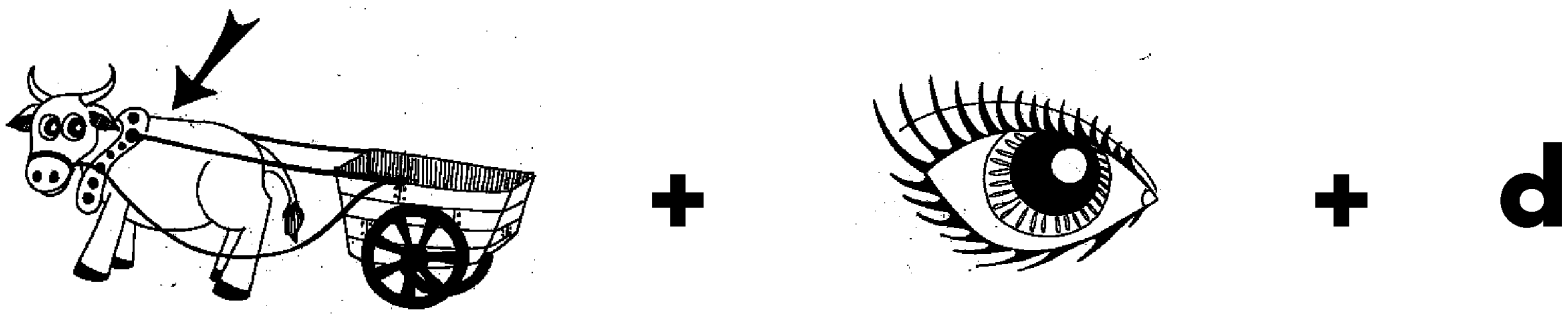

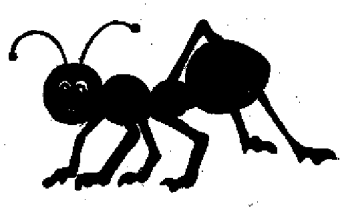

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Road Survey

Title: _____ **Name:** _____

Number of people per car	**Street** _____	
	Mark an 'X' for each car	**Number of people**
one		
two		
three		
four +		

Total cars	**Total people**

Time of Day	
Weather	

Pick a good location to survey. Count the number of passengers in each car that passes by and mark an 'X' in the appropriate box. For example, if a car has 3 people in it, put an 'X' beside 'three'. Later, figure out how many cars passed by the location by counting up all the 'X''s and put the number under 'Total cars'. To figure out how many people passed by your survey spot, multiply the number of people in each car by the number of cars with that many people. For example, if four 'two passenger cars' went by, then multiply 2 x 4 to find 8 people. Put '8' under the 'Number of people' column and across from 'two'. Add up the number of people and put the number under 'Total people'. Remember to write in a title for the survey, your name, the name of the street you surveyed on, the time of day you surveyed and the weather conditions.

How does public transit and carpooling save space on the roads?

Students at West Humber Collegiate in Etobicoke investigated this question with the help of the TTC.

In this photos, the students demonstrated how much space is required to transport 40 students on the bus and in single passenger cars.

In the photos on the right, note how little space passengers use in a bus, and how inefficiently students are spread out in their cars.

You can do a similar experiment with your class:

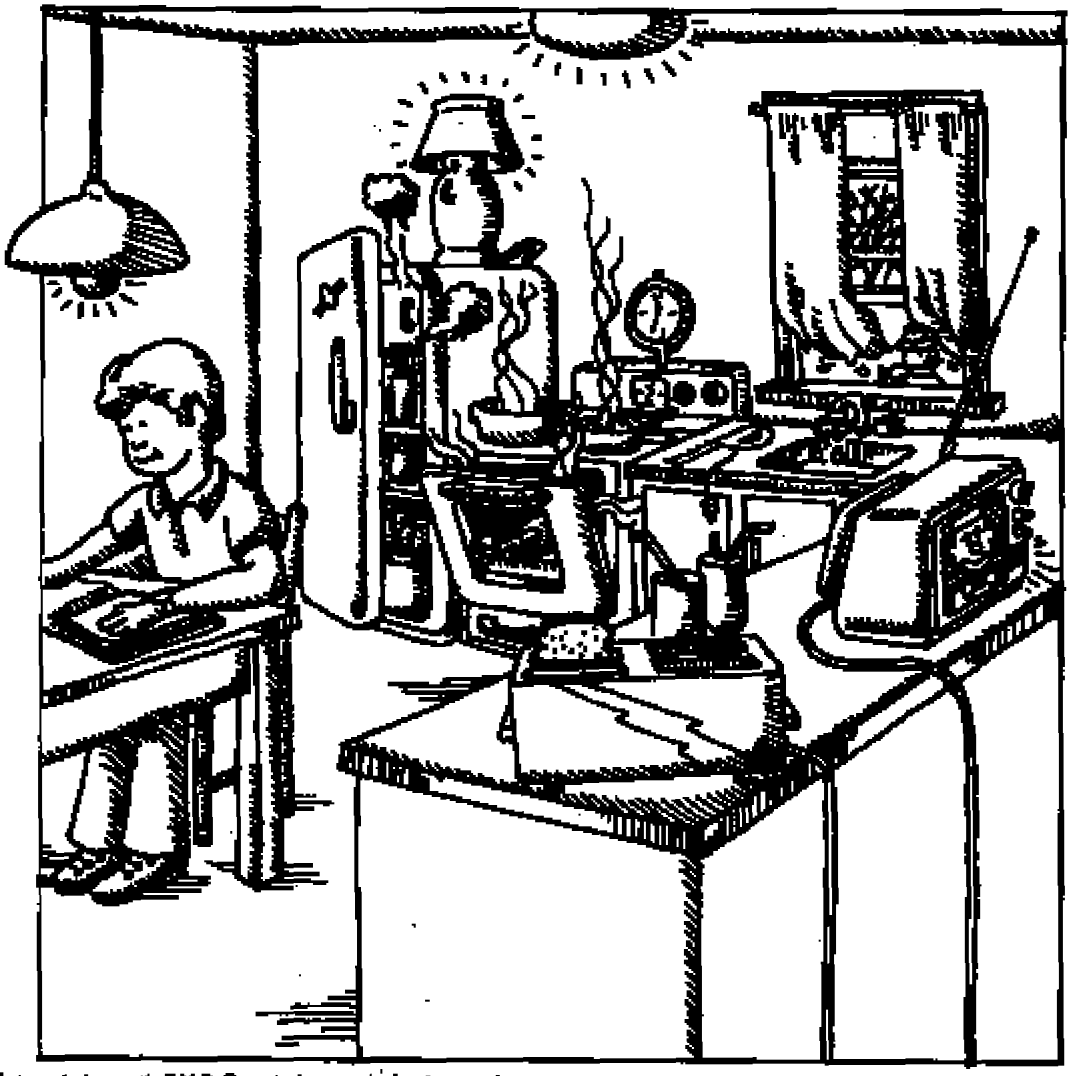
- go to the gym or outside and have your class sit closely together as they would on a bus
- take a picture if possible
- have the students sit 2 metres apart as they would in cars
- take a second picture for comparison

Discuss with the implications for traffic if more people took the bus. What would happen if people car pooled? How would this benefit the atmosphere? Any other benefits?

FACT: One street car replaces 47 cars and carries 61 passengers. (Based on an average of 1.3 people per car).

Find the Energy Waste

Joey's family has a very high energy bill because they waste energy. Can you tell them how to save energy? Find 11 ways that energy is being wasted in Joey's kitchen. The answers are at the bottom of this page.



Turn the TV off.
Fix the dripping tap.
Close the window.
Put lids on the food so it will cook faster.
Unplug one of the electric clocks.
Turn off extra lights.
An electric knife is unnecessary. A hand knife works just as well and uses no electricity.
Close refrigerator door.
Close oven door so heat can't escape.
Buy pop in returnable bottles; it takes less energy to reuse them than to make a new one.
Use a two-slice toaster; it uses less energy.

Acknowledgement: E.M.R. Canada for permission to recycle.

Frank Allan. "Find the Energy Waste" in My Home, Your Home, pg. 104.

Light Patrol

Check to see if:

- Lights are turned off in areas where sunlight can be used.
- Lights are turned off in hallways, classrooms,closets, etc. when not in use.

Be sure to check at different times of the day (see below). Choose different student patrols for each area and rotate on a weekly basis.

☺ **Good conservation of energy**

☹ **Waste of energy**

	Mon	Tues	Wed	Thurs	Fri
Classroom					
Morning					
Lunch					
Recess					
End of Day					
Hallway					
Morning					
Lunch					
Recess					
End of Day					
Washroom					
Morning					
Lunch					
Recess					
End of Day					
Other					

Week #_____

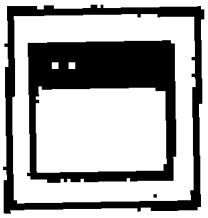
Home Energy Efficiency Tips

There's just so much you can do!

Residential energy: 70% is used to heat and cool homes, 20% is used to heat water and the remaining 10% is used for lighting, cooking and running small appliances.

Things you can do in the Kitchen:

Dishwasher

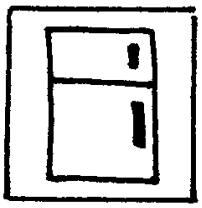


- Make sure that the dishwasher is full before you turn it on.
- Use the short or energy cycle - you can actually use less energy than washing your dishes by hand.
- Don't use the dry cycle (it is the one that uses the most energy), open the dishwasher door instead.

Stove

- Using a microwave to heat a bowl of soup uses less than half the energy you would use to heat the soup on the stove.
- Use the smallest appliance available.
- Use lids for boiling and cooking whenever possible.
- Use limited amounts of water for cooking.
- Lower the heat when food comes to a boil to maintain a gentle simmer; food does not cook any faster with brisk boiling.
- A kettle used on a natural gas stove is more energy efficient than an electric kettle, but an electric kettle is more efficient than a kettle used on an electric stove.
- Keep the burner reflectors clean so they reflect all the heat possible.

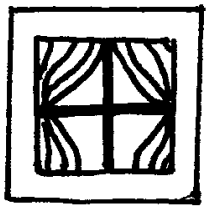
Refrigerator



- Set the thermostat in the refrigerator at the most efficient temperature (3°C) and set the freezer to -18°C.
- At just a few degrees cooler, your energy bills could be 10% lower.
- Vacuum the coils at the back of the fridge twice a year to increase efficiency.

Things you can do in the Living/Family room:

Windows



- In the winter, open the drapes where there is sun facing the windows so that the sun can warm your house; remember to close them as soon as the sun goes down.
- In the summer, keep the drapes closed where there is sun facing the windows to keep the house cool and open them at night to let the cooler air in.

Television and radio

- Turn off the TV and radio when no one is watching or listening to them.
- Unplug your TV when you are going away for awhile if it is the "instant-on" type - these TVs use up to 8 watts of standby power just waiting for you to turn them on.

Lighting

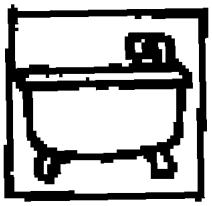
- It is more efficient to use one big light bulb than 3 or 4 smaller ones in lighting an area.
- Try compact fluorescent bulbs (an 18 watt fluorescent bulb gives off the same light as a 75 watt incandescent bulb and lasts 13 times longer!)
- Always turn off lights when no one is in the room.

Heating/Cooling

- Turn down the thermostat when you are sleeping.
- Set the thermostat at 18°C or lower if you are comfortable, 20°C when you are working and 16°C when you are away from home.
- In the coldest winter months you can save up to 15% on your fuel bills by lowering your thermostat 5°C for four or more hours each day.
- Draft proof your house, insulate your basement and attic, and super-insulate if you renovate.
- In the winter, wear a sweater and slippers and turn down the thermostat, especially at night.
- Keep air ducts in your house clear of furniture and objects.
- Do not leave the door open to your house in the winter or you'll be letting the cold air in and the warm air out.
- In the summer, sleep in the basement if possible, to avoid using the air conditioner.

Things you can do in the Bathroom:

Shower/Bath



- Ask your parents to turn your hot water heater down 5.5°C and take shorter showers; hot water heaters are the second biggest energy users in the home!
- Insulate the heater.
- Most people suggest a short shower uses less hot water than a bath. Decide for yourself -the next time you take a shower, put a plug in the drain and measure the amount of water your shower uses.
- Change the showerhead to a low-flow one head. It could cut the amount of hot water you use by half.
- After taking a bath, leave the hot water in the tub for a while - the water will help heat the room.

Taps

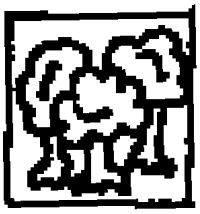
- Fix leaky taps - one drop of water a second adds up to 16 baths a month.
- Install an aerator on your sink faucet to cut your water flow in half and do not allow the water to run as you shave or brush your teeth.

Shaving

- An electric shaver uses less energy in a year than it takes to heat hot water for shaving with a regular razor in a week (the most obvious purchase is not always the most helpful to the environment).

Things you can do 'in and around' the house:

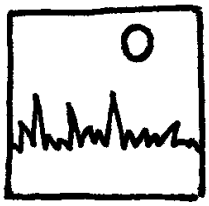
Trees



- Trees not only absorb CO_2, they also provide shade, cutting down the need for air conditioning.
- 3 well-placed trees around a house can cut air conditioning needs by 10-15%.
- Plant evergreen trees on the sides of your home not facing the sun and deciduous trees (broad-leaved trees) on sunny sides.

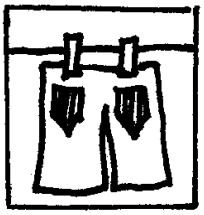
- A tree that provides shade and cooling indirectly causes reductions in CO_2 emissions equivalent to 15 times the amount of CO_2 the tree alone can absorb.
- So go and plant some trees!!

Lawn



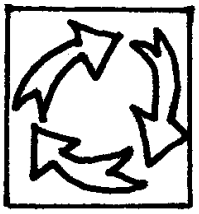
- Use a push type lawnmower instead of a gasoline-driven one - this helps reduce smog too.

Laundry



- Hang your clothes out in the summer instead of using the dryer.

Recycling

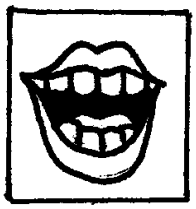


- Recycling requires a lot less energy and natural resources than using new materials each time.
- Buy things made from re-cycled material; it takes less energy to make products from recycled materials than to make them from scratch.
- Recycling an aluminum pop can saves the same amount of energy that it takes to run a TV for 3 hours, but refillables bottles save even more.
- Always keep in mind the '4 R's'(in this order): Refuse, Reduce, Reuse and Recycle.

Cars

- When the car is hot and stuffy, roll down the windows to cool it down instead of using the air conditioner which burns more fuel.
- Don't drive on the highway with an open sun roof or windows. At such a speed,the air blowing into the car creates a resistance to the car moving forward and more fuel is needed to power the car.
- Use the car's flow-through ventilation to provide fresh air for passengers.
- Avoid idling, which eats up gas;one minute of idling uses up more fuel than starting your engine.
- Cut down on car use - try to car pool, walk, bike or take the public transit. The most crucial times to cut down on driving are days when a smog warning is in effect. Nitrogen oxides which is emitted through car exhausts is a major component of smog.

Voice your concerns



- Write to businesses that you see wasting energy, e.g. office buildings that leave their lights on overnight, buildings that are overheated or over air conditioned, and companies that put too much energy-wasting packaging on their products.

More Facts:

- Canadians are the world's biggest per capita energy consumers: we consume 2 times as much as Japan or Sweden and 3 times as much as Denmark.
- Americans are the second biggest per capita energy consumers.
- If you leave a 100 watt electric light on twelve hours a day for a whole year, it will use enough electricity to burn almost 180 kg of coal. Burning this coal will release 450 kg of CO_2 and 3.5 kg of acid rain.
- Turning off a typical desktop computer, monitor and printer on nights and weekends for six years will lower your electricity bill enough to pay for the whole system.

Lots O' Neato Facts About Climate Change

Did you know. . .

- Venus receives roughly the same amount of the sun's energy as the Earth, but its surface temperature is a scorching 370°C. The difference is due to the level of carbon dioxide in each planet's atmosphere. Carbon dioxide (which absorbs heat) makes up 97 percent of Venus's atmosphere. By comparison, only 0.03 percent of the Earth's atmosphere is made up of carbon dioxide.

- Urban areas are known as "heat islands" because pavements and rooftops absorb and store more heat than fields and trees, so cities have warmer climates than rural areas.

- Temperatures in the last Ice Age 10,000 years ago were only 5 degrees less than today's average world temperature.

- The ten hottest years ever recorded have all occurred since 1980, and 1995 was the hottest.

- You may have been put to sleep at your dentist's office by laughing gas. Laughing gas is really nitrous oxide (N_2O).

- Scientists test air bubbles trapped in glaciers to discover how much CO_2 was in the atmosphere hundreds or thousands of years ago.

- When sunlight reaches the Earth, it is converted to heat.

- Every year, a section of the Amazon rainforest that is bigger than the size of Britain is slashed and burned. Huge areas of temperate and boreal forests are also cut down in countries like Canada.

- Over the past 240 years, the level of methane in the atmosphere has doubled.

- Five billion tonnes of CO_2 is released per year from the burning of oil, coal and gasoline. About 500 million tonnes come from Canada.

- Studies show that Canada can cut its energy demands by half, without affecting living standards.

- If all businesses in Ontario used energy-efficient lighting, we could close down two large nuclear reactors or four coal-burning generators.

- Canadians are the world's biggest per capita energy consumers. For example: Canada consumes 2 times the energy of Japan or Sweden and 3 times more than Denmark.

- Americans are the second biggest per capita energy consumers.

- 70% of residential energy is used to heat and cool homes, 20% to heat water and 10% for lighting, cooking and running small appliances.

- If every person who used electricity replaced one light bulb with an energy-efficient compact fluorescent light bulb, fifty of the world's largest nuclear power plants could be shut down.

- Twice as many Canadians own boats as snowmobiles. There are more golfers than downhill skiers in Canada. We import almost a quarter of a million umbrellas each year and nearly a quarter of our homes have air conditioning (almost half of those are in Ontario).

- CLIMATE is the sort of temperatures and precipitation (rain and snow) we can expect over the long term. WEATHER refers to the day to day changes. **Climate is what we expect, weather is what we get.** We buy clothes because of the climate, we wear clothes because of the weather.

- Our climate has sparked some remarkable Canadian inventions like the snowblower, frozen fish, insulation, underground shopping malls, winter fuels and all-weather asphalt. The game of ice-hockey is not a Canadian invention, but basketball is!

- If we think of the Earth as an apple, the atmosphere is about as thin as the skin of the apple. The lower atmosphere consists of the first two regions called the troposphere and the stratosphere. Together they are only about 50 km high.

- A tap that drips once every second wastes about 10,000 litres of water per year.

- Canadians generate lots of waste - about 1.7 kg each per day. Per capita, this is about twice as much as Sweden.

- Once organic waste gets covered over and packed down in a landfill, it is exposed to very little oxygen. This means it decays very slowly, and gives off methane. Since methane is a greenhouse gas, landfills contribute to climate change.

Colonel Draft Inspector and the Draft Stopper

Motivation: The average home loses 1/4 of its heat through air leaks.

Materials: **Draft Detector** : feather, ribbon, tissue, pencil, tape or incense. **Draft Stopper** : old pair of tights, dried beans or uncooked rice, elastic band, buttons, thread and other decorations.

Procedure:

1. Consider the school building or house. Think of likely locations where drafts may be found. These might include:
   - ➢ all doors to the outside
   - ➢ electrical outlets
   - ➢ all windows
   - ➢ turns in the hallway, key intersections and stairways
2. Make copies of a map of the school, if the school is to be inspected. Assign specific locations to groups of students.
3. To make a draft detector, cut the tissue paper into strips of 3cm by 6cm, 6cm by 12cm and 12cm by 25cm. Attach the paper to the pencil in a manner similar to a flag to make a small, medium and large draft detector.
4. Have the students check their assigned locations around their school or home for drafts with their draft detectors. If the draft detector moves, cold air is sneaking into the building.
5. Have the students record the location and size of a draft.
6. Have the class compile the results on an overhead transparency, using a colour code to indicate small, medium and large drafts.
7. Have a discussion to analyze the results:
   - Is there a pattern to the results?
   - Are there areas of the school that have more severe drafts? (possibly an old wing)
   - How do drafts affect the comfort of those in the room?
8. Prepare a written report for the principal, custodian or school board, including recommendations.

How To Make A Draft Stopper To Shut Out An Air Leak:

- Cut the legs off a pair of old tights.
- Line one leg with the other, so you have a double thickness.
- Stuff the leg with the beans or rice and secure the open end tightly with an elastic band.
- For decoration, sew on button eyes, forked tongue and other decorations.
- Place the draft stopper along the bottom of the drafty door or window.

Shut the Fridge Door!!

Motivation: Every time you open the fridge, cold air escapes, so the fridge has to use more energy to keep cool!

Activity:

- For one week tape this sheet on the front of your fridge with a pencil attached on a string.
- Ask each member of your family to mark the chart EVERY time they open the fridge.
- Add the check marks up at the end of each day and take the average for the week and compare with the average household which is 22 times a day.

What To Do:

- Think about what you want before you open the fridge.
- Label all containers so you do not have to waste time searching for what you want.
- Ask your family to make a conscious effort to limit the number of times they open the fridge and test yourselves again using another chart. Was there a difference?

FRIDGE MONITOR:

Don't forget to check off when you open the fridge door!!

Name	Mon	Tues	Wed	Thurs	Fri	Sat	Sun

Writing Letters

It is important to express your opinion on environmental issues. One good method of having your voice heard is by writing letters. You may think that one letter may not make a difference, but you would be surprised!

Some people you may want to consider writing to are:

- your local politicians
- polluting companies or high energy consuming office buildings
- newspapers, TV stations, magazines, etc.
- environmental groups

Follow these six tips when writing a letter on controversial issues:

1. Introduce yourself and say why you are for or against an issue.
2. Be clear and to the point. Cover only one subject in each letter.
3. Make your letter one page or less.
4. Invite a response to your letter. Simply saying, "I look forward to your reply" usually works.
5. Be sure to thank the person you wrote to if they do what you ask.

On issues concerning provincial legislation write to:

- your local member of provincial parliament (MPP)
- the premier of your province
- the minister of natural resources or the environment

On issues concerning federal legislation write to:

Your local provincial or federal Member of Parliament.

The Honourable_____
Queens Park
Toronto, Ontario
M7A 1A1

The Honourable _____
House of Commons
Ottawa, Ontario
K1A 0A6

On national or international issues, you can also write to:

The Prime Minister of Canada:
The Honourable _____
House of Commons
Ottawa, Ontario
K1A 0A6

or

The President of the United States:
President _____
The White House
1600 Pennsylvania Avenue, NW
Washington, D.C. 20501, U.S.A.

Don't Stop There...Take More Action

(Action Steps)

For enthusiastic teachers or students who want make their school and community as atmospherically-friendly as possible, we've created a list of action steps. Some of these activities involve a small group like your school's environment committee, while others require the participation of the whole school. Whatever you choose, you will be helping to reduce CO_2 emissions around your school. Now, get out there and ACT!

1. **Start an Eco Newsletter.** Start up your own conservation newsletter. Set up an editorial committee; appoint journalists and artists and start printing!
2. **Safe Routes to School Program.** Organize a Walking School Bus to your school. Find parent volunteers or older students who are willing to go door to door on a particular street close to the school, pick up younger students and walk them to and from school. Parents and teachers will have to work closely on this project together. If you are in the Toronto area, speak to Jacky Kennedy at the Greenest City office (416) 977-7626 to help get you walking.
3. **Organize a tree planting day.** Tree planting is an opportunity to connect physically and emotionally with your surroundings and learn a lot about the environment. At the same time, you will be creating a local 'carbon sink' and saving energy. The right trees planted next to the school building can help to shade classrooms in the summer or act as windbreakers that block cold winds in the winter. Refer to the Resource section for organizations that can help you choose the appropriate tree species for your area or contact a local conservation office.
4. **Plant a community garden.** Here's a chance to get the whole community involved. Find an ideal space around your school and start digging! If you need to break asphalt, you may need to obtain approval to landscape from your school board. Think about going to visit an established community garden before you begin on your own.
5. **Start a composting project.** Correctly composting your food and yard waste eliminates the methane that they would produce at the dump. Assign students to monitor the project.
6. **Start a reuse project at your school.** It takes much less energy to reuse a product than it does to make a new one. Start a school collection of old jars, containers and anything else you think the school could use. Send out a flyer to parents and put up posters at school.
7. **Draft proof your school.** A lot of energy is wasted from air leaks. Survey the school building for air leaks and loose doors. Create draft stoppers by stuffing old stockings with dry rice or beans and place them on top of the leaks. Have your custodian fix loose doors.
8. **Organize a 'Switch it off Day or Week'.** See if your whole school can go without electricity for an entire day or week. Hold an assembly or perform a play in front of the school in order to teach them about why reducing our energy is so important.

Resource Section Overview
(for the Greater Metropolitan Toronto):

Books from Metro Libraries
- Climate Change/Global Warming
- Greenhouse Effect
- Energy Conservation

Other Books and Publications

Organizations

Tours, Field Trips and Guest Speakers
- Energy
- Transportation
- Tree Planting
- Miscellaneous

Videos

Books from Metropolitan Toronto Libraries

Climate Change/Global Warming

Allaby, Michael. Living in the Greenhouse. Wellingborough,1990.
363.7392/A
LOCATION: Etobicoke, Scarborough (Agincourt District,Albert Campbell District, Cedarbrae District, Guildwood).

Asimov, Isaac. Is Our Planet Warming Up? Milwaukee: Gareth Stevens Children's Books,1992.
J363.7387/ASI
LOCATION: Etobicoke, North York, Scarborough (Agincourt District,Bridlewood,Goldhawk Park, Steeles and Woodside Square).
Reviewed: aimed at young age group, very simple explanations and a good range of topics from natural changes in climate to the actual workings of the greenhouse effect;includes glossary.

Baines, John. Conserving the Atmosphere. Hove: Wayland,1989.
J363.7392/B
LOCATION: Etobicoke, Scarborough (Cedarbrae District,Highland Creek, Malvern and Port Union).

Bilger, Burkhard. Global Warming. New York: Chelsea House Publishers,1992.
J363.7387/BIL
LOCATION: Etobicoke, North York, Scarborough (Agincourt District,Bridlewood,Cedarbrae District, Morningside, Port Union, Steeles and Woodside Square), Toronto.
Reviewed: very detailed, discusses the role of governments around the world and the use of economics to try and alleviate the problem.

Blashfield, Jean F. Global Warming. Chicago: Childrens Press,1991.
J363.7387/B
LOCATION: Etobicoke, North York,Scarborough (Agincourt District,Albert Campbell District, Cedarbrae District,Goldhawk Park, Guildwood, Highland Creek,McGregor Park and Malvern), Toronto.
Reviewed: discusses all topics in detail, especially the science side of global warming and the ozone layer.

Gersham, Janis. Global Warming: a teacher's resource. Toronto: McGraw-Hill Ryerson, 991.
363.738707/GER
LOCATION: Scarborough (Albert Campbell District).

Gutnick,Martin J. Experiments That Explore The Greenhouse Effect. Brookfield: Millbrook Press,1991.
363.7392/GUT
LOCATION: Etobicoke, Scarborough (Albert Campbell District,Bendale, Bridlewood, Cedarbrae District,Highland Creek, Kennedy).

Hare, Tony. Polluting the Air. New York: Gloucester Press,1992.
J363.7392/HAR
LOCATION: Etobicoke, Scarborough (Albert Campbell District,Bendale, Bridlewood,Cliffcrest, Highland Creek, Kennedy, Malvern,Morningside and Woodside Square).

Johnson, Rebecca. The Greenhouse Effect: Life on a Warmer Planet. Minneapolis: Lerner publications,1990.
J363.7387/JOH
LOCATION: Etobicoke, Scarborough (Agincourt District,Albert Campbell District, Bendale, Bridlewood, Cedarbrae District, Eglinton Square, Goldhawk Park, Kennedy, McGregor Park, Malvern,Maryvale, Steeles and Woodside Square).

Karas, J.H. The Heat Trap: the threat posed by rising levels of greenhouse gases. Ottawa:Friends of the Earth,1989.
551.6/KA
LOCATION: Scarborough (Agincourt District,Bridlewood, Highland Creek,Maryvale and Woodside Square).

Koral,April. Our Global Greenhouse. New York: F. Watts,1989.
J363.7392/KOR
LOCATION: Etobicoke, all Scarborough branches.

Mosley, Michael. Environment: Climate in Crisis. London: Boxtree, 1993.
J363.7392/MOS
LOCATION: Etobicoke, Scarborough (Agincourt District,Bendale, Cedarbrae District,Goldhawk Park, Guildwood and Port Union).

Neal,Philip. The Greenhouse Effect & Ozone Layer. London: Dryad,1989.
363.7392/NEA
LOCATION: Etobicoke, Scarborough (Agincourt District,Albert Campbell District, Bendale, Bridlewood,

Cedarbrae, Eglinton Square, Kennedy, Steeles and Woodside Square).

Peckham,Alexander. Global Warming. New York: Gloucester Press/ Aladdin Books, 1991.
J363.7387/PEC
LOCATION: Etobicoke, North York, Scarborough (Agincourt District,Albert Campbell District,Bridlewood,Malvern,Steeles and Woodside Square), Toronto.
Reviewed: good use of pictures,especially from around the world.

Pringle, Laurence. Global Warming. New York: Arcade Publishing, 1990.
LOCATION: East York, Etobicoke, North York, all Scarborough branches, Toronto, York.

Tesar, Jenny. Global Warming. New York: Facts on File, 1991.
J363.7387/PRI
LOCATION: East York,Etobicoke, North York, all Scarborough branches, Toronto, York.
Reviewed: good in-depth discussion on energy conservation.

Woodburn, Judith. The Threat of Global Warming. Milwaukee: Gareth Stevens, 1992.
J363.7387/WOO
LOCATION: Etobicoke, North York, Scarborough (Agincourt district,Albert Campbell District,Bendale, Cedarbrae District,Eglinton Square, Goldhawk Park, Guildwood,Malvern,Morningside and Woodside Square).

Greenhouse Effect

Bright, Michael. The Greenhouse Effect. New York: Gloucester Press, 1991.
J363.7387/BRI
LOCATION: Etobicoke, North York, Scarborough (Agincourt District,Albert Campbell District,Cedarbrae District,Goldhawk Park,Guildwood, Malvern,Maryvale and Woodside Square), Toronto, York.
Reviewed: very good coverage of all the necessary topics (i.e. natural causes, other causes,the effects and natural controls), includes a glossary.

Hare, Tony. The Greenhouse Effect. New York: Gloucester Press, 1990.
J363.7/H
LOCATION: East York,Etobicoke, North York,Scarborough (Agincourt District,Albert Campbell District, Bridlewood, Cedarbrae District, Guildwood,Malvern, Morningside, Port Union and Steeles), Toronto, York.
Reviewed: good coverage of all of the topics.

Harris, Jack C. The Greenhouse Effect. New York: Crestwood House, 1990.
J363.7387/HAR
LOCATION: Etobicoke, Toronto.
Reviewed: good detail of all the related topics and appropriate reading level.

Rybolt,Thomas R. Environmental Experiments about Air. Hillside: Enslow Publishers,1993.
J328.5307/RYB
LOCATION: Etobicoke.

Stille, Darlene R. The Greenhouse Effect. Chicago: Childrens Press,1990.
J363.7392/S
LOCATION: East York, Etobicoke, North York,all Scarborough branches, Toronto, York.

Thompson, Sharon. Greenhouse Effect. San Diego: Lucent Books,1992.
J363.7387/THO
LOCATION: Etobicoke, Scarborough (Albert Campbell District, Cedarbrae District,Guildwood, Highland Creek, Malvern,Morningside, Steeles ans Woodside Square), York.

Energy Conservation

Bailey, Donna. Conserving Energy. New York: F. Watts, 1991.
J333.7916/BAI
LOCATION: Etobicoke, North York,Scarborough (Agincourt District, Cedarbrae District, Goldhawk Park, Guildwood, Highland Creek,Malvern, Morningside, Port Union and Woodside Square).

Boyle, Desmond. Energy. New Jersey: Silver Burdett Co.,1982.
J333.79/BOY
LOCATION: Etobicoke, Scarborough (Agincourt District,Albert Campbell District, Bendale, Bridlewood, Eglinton Square, McGregor Park,Morningside and Woodside Square).

Branley, Franklin. Feast or Famine? The Energy Future. New York: Crowell,1980.
J333.79/BRA
LOCATION: Scarborough (Cedarbrae District and Port Union).

Brown, Warren. Alternative Sources of Energy. New York: Chelsea House Publishers, 1994.
J333.79/BRO
LOCATION: Etobicoke, Scarborough (Agincourt District,Cedarbrae District, Guildwood,Highland Creek,Morningside and Port Union).

Collinson,Alan. Renewable Energy. London: Cloverleaf, 1991.
J333.794/C
LOCATION: Etobicoke, all Scarborough branches.

Gardiner, Brian. Energy Demands. London: Gloucester Press, 1990.
J333.9712/GAR
LOCATION: Etobicoke, all Scarborough branches.

Gardner, Robert. Experimenting with Energy Conservation. New York: F. Watts,1992.
J621.042/GAR
LOCATION: Etobicoke, Toronto.
Review: very advanced, science-based with some physics formulas.

Gardner, Robert. Save that Energy. New York: J. Messner, 1981.
LOCATION: Etobicoke, Scarborough (Albert Campbell District,Guildwood, Maryvale and Port Union), Toronto, York.

Gutnik,Martin J. The Energy Question: Thinking About Tomorrow. Hillside: Enslow Publishers,1993.
J333.79/GUT
LOCATION: Etobicoke, Scarborough (Albert Campbell District, Bendale, Bridlewood, Cedarbrae District,Highland Creek, Kennedy and Port Union).

Hamer, Mick. Transport. New York, F. Watts,1982.
J380.5/HAM
LOCATION: Scarborough (Albert Campbell District, Cedarbrae District,Cliffcrest,Eglinton Square, Guildwood and Woodside Square).

Johnstone, Hugh. Facts on Future Energy Possibilities. New York:
F. Watts, 1990.
J333.794/JOH
LOCATION: Etobicoke, all Scarborough branches.

Kiefer, Irene. Energy for America. New York, Atheneum, 1979.
J333.79/KIE
LOCATION: Scarborough (Bridlewood,Cedarbrae District,McGregor Park and Morningside).

Knapp, Brian. Don't Waste Energy. Toronto: Grolier, 1993.
J333.7916/KNA
LOCATION: Etobicoke, North York.
Reviewed: good discussion on all the different types of energy conservation.

Lambert, Mark. Energy Technology. East Sussex: Wayland,1991.
J333.79/LAM
LOCATION: Etobicoke, Scarborough (Agincourt District,Cedarbrae District,Goldhawk Park, Highland Creek,Morningside and Woodside Square).

Lambert, Mark. Future Sources of Energy. East Sussex: Wayland , 1986.
J333.7912/LAM
LOCATION: Scarborough (Agincourt District, Bridlewood).

O'Neill,Mary. Power Failure. Mohwah: Troll Associates,1991.
J333.79/O
LOCATION: Etobicoke.

Tanaka,Shelley. The Heat Is On. Toronto: Douglas & McIntyre, 1991.
J333.7916/T
LOCATION: East York,Etobicoke, North York, all Scarborough branches, Toronto.
Reviewed: many good tips on what children can do to conserve energy and reduce CO_2 themselves.

Yanda,Bill. Rads, Ergs & Cheeseburgers: The Kid's Guide to Energy & The Environment. New York: J. Muir Publications, 1991.
J333.79/YAN
LOCATION: Scarborough (Agincourt District, Bridlewood, Goldhawk Park, Steeles and Woodside Square).

Watson, Jane. Alternative Energy Sources. New York: F. Watts,1979.
J333.7/WAT
LOCATION:Etobicoke, Scarborough (Agincourt District, Albert Campbell District,Cedarbrae District,Highland Creek,Maryvale, Port Union and Woodside Square).

Other Books & Publications

Model Round Table for Youth Kit
National Round Table on the Environment and the Economy
1 Nicholas Street,Suite 1500
Ottawa, ON
K1N 7B7
tel (613) 992-7189
fax (613) 992-7385
$ free

Rysberman, F.R.and Stewart, R.J. ed.
Targets and Indicators of Climatic Change
The Stockholm Environment Institute
Box 2142
S-103-14
Stockholm, Sweden

Degrees of Change
steps towards an Ontario Global Warming strategy.
Prepared for: Ontario Ministry of Energy
Ontario Ministry of the Environment
by the Ontario Global Warming Coalition, June 1991
56 Wellesley St W
Toronto, ON
M7A 2B7
(416) 327-1234
- *strategies and figures for residential sector, commercial, transportation, industrial*

The Greenhouse Game; The Environmental Game
The Kit Company
128 Walmer Rd.
Toronto, ON
M5R 2X9
(416) 922-3654
$24.95
grades 4-6
- *an entertaining and informative game on the greenhouse effect*

What We Can Do For Our Environment.
Environment Canada
Contact: Environment Canada's Inquiry Centre
351 St. Joseph Boulevard
Hull,PQ
K1A 0H3
$ free

One Earth
Educational Services
Metro Toronto School Board
45 York Mills Rd
North York,ON
M2P 1B6
tel (416) 397-2509
fax (416) 397-2640
- *uses environmental themes in developing language skills for ESL students*

The Global Warming Primer
Conservation Council
180 St. John St.
Fredericton,NB
E3B 4A9
- *concise booklet with excellent graphics*

Directories
The Canadian Environmental Education Catalogue
The Pembina Institute for Appropriate Development
Box 7558 Drayton Valley, AB
T0E 0M0
tel (403) 542-6272
fax (403) 542-6464
- *comprehensive listing of educational resources indexed by subject*

Tours, Field Trips and Guest Speakers

Energy

ONTARIO HYDRO:
Darlington Nuclear Generating Station
1-800-461-0034

- Darlington offers a 1.5-2 hour bus tour for classes.
- staff provide a presentation on how the plant works, and then a bus tour of the buildings
- open M-F 9:00-3:30,closed weekends and holidays
- tours need not be booked far in advance
- free

Lakeview Thermal-Electric Generating Station
Missisauga, ON
Contact:Jim Hall
(905) 274-3461

- tours are planned by the teacher and Jim Hall to meet the specific needs of the class
- at least 2 weeks notice
- free

Transportation

Better Transportation Coalition
517 College Street,Suite 325
Toronto, ON
M6G 4A2
tel (416) 961-5767
fax (416) 961-5850
or contact: Shannon Thompson
home (705) 652-1903
fax (705) 652-1902
E-mail - sthompson@web.apc.org

- BTC aims to reduce car dependency, improve all forms of public transportation,promote equity of access to transit, and improve urban design and planning so that it supports walking, cycling,and public transportation.
- BTC has developed a lesson on transportation issues within the community which covers air quality, community space, comparison of transportation issues (eg. space, health concerns,cost).
- the lesson includes video, handout and post activities.

Metro Transportation
tel (416) 392-8329
Contact:Tom Mulligan

- speakers can be arranged on an individual basis
- no school presentation already developed
- can speak on issues of traffic calming, bike lanes, public transit,how the road system works to keep traffic moving in metro

Safe Routes to Schools Program
Greenest City Office
tel (416) 977-7626
Contact: Jacky Kennedy

- provide help on developing your own Walking School Bus
- the idea involves volunteers from the community who act as Walking School Bus Drivers and walk children to and from school.

Tree Planting:

Urban Forests Associates (UFA)
331 Lynsmere Cres.
Toronto, ON
M4J 4M1
tel (416) 423-3387
fax - same number
Contact: Steve Smith

- the UFA will do tree planting with interested groups on a project-specific basis
- projects are planned by UFA,although in the past classes have designed their own
- UFA tries to find partnerships with community groups to offset the costs of projects.
- this group is a great resource for classes interested in putting in the time to design and implement a tree planting plan.

CITY OF TORONTO
Parks and Forestry
tel (416) 392-0494
Contact:Gary Leblanc

- the City of Toronto organizes a tree planting with the Toronto Board of Education and the Toronto Separate School Board to coincide with Arbour Day on the last Friday of April
- in March, letters are sent to board offices to be distributed to schools
- contact your board office for information,and not the City directly.

TREES ONTARIO
Ontario Forestry Association
502-150 Consumers Road
Willowdale, ON
M2J 1P9
tel (416) 493-4565
fax (416) 493-4608
Contact: Hollie Mayfield

- Trees Ontario provides funding and coordinates tree planting projects that benefit the general public (park setting, aesthetics, shade for public buildings or areas). Schools provide volunteer planters.
- project proposals must include provision for future tending of the site, including weed control.

TREES ON YOUR STREET
City of Scarborough
c/o Recreation Parks and Culture Dept.
150 Borough Drive
Scarborough, ON
M4P 4N7
tel (416) 396-7406

- the City of Scarborough provides trees for planting on city property on a cost-sharing basis
- up to 11 species of trees are available
- barefoot trees are between 2.4 to 3 m in height, with a trunk -diameter of 30 mm for $38.00 CDN
- balled and burlapped trees at 3 to 4m tall,with a trunk diameter of 60 mm are available for $214.00 CDN
- Deadlines: February 1st for spring planting September 1st for fall planting

Task Force to Bring Back the Don
Contact: David Stonehouse
tel (416) 392-0401

- The Task Force conducts planting projects in the spring and fall in the Don Valley. There is no cost to the school,although teachers should book far in advance.
- Guest speakers on topics such as urban forestry, reforestation, the Don,and other subjects are available. Tours of the Don, including talks about habitat are also possible.

Miscellaneous:

The Body Shop
33 Kern Road (near York Mills and Leslie)
tel (416) 441-3202

- the Body Shop offers tours of its innovative offices
- energy saving equipment,the daycare centre, the cafeteria,the warehouse, etc. are discussed
- the 'Living Machine' is a sewage treatment system that treats all wastes on site
- 45 minutes to 1 hour
- free

Organizations

The Everg reen Foundation
24 Mercer St
Toronto, ON
M5V 1H3
tel (416) 596-1495
fax (416) 596-1443

- Evergreen promotes and works to establish natural areas in urban environments through education and responsible action.

Friends of the Earth
701-251 Laurier Ave W
Ottawa,ON
K1P 5J6
tel (613) 230-3352
fax (613) 232-4354

- free Climate Change Workshop
- 10 things you can do to stop Global Warming

Green Brick Road
Contact: John Tersigni
mailing address: c/o 8 Dumas Court, Don Mills,ON
M3A 2N2
Located at: 3 Jackman Ave.,(Carrot Common), Toronto
tel (416) 465-1597
fax (416)537-7515

- Excellent resource centre for environmental/global educational materials and teacher workshops.

Green Teacher Magazine
Education for Planet Earth
95 Robert Street
Toronto, ON
M5S 2K5
tel (416) 960-1244
fax (416) 925-3474

- bimonthly magazine full of resources and practical environmental lessons
- issue 32 (Feb-Mar 1993) and 51 (Spring 1997) focus specifically on energy and climate change (see our own Roundtable Discussion - Lesson 17 featured in issue 51!).

Toronto Environmental Alliance (TEA)
122 St. Patrick St., Suite 209
Toronto, ON
M5T 2X8
tel (416) 596-0660
fax (416) 596-0345
e-mail:tea@web.net

- TEA aims to enhance the natural and human environment in the Toronto area and make Toronto a more environmentally sustainable city.

Videos

NATIONAL FILM BOARD OF CANAD A
English Marketing, D-5
P.O. Box 6100, Station Centre-Ville
Montreal, Quebec
H3C 3H5
fax (514) 496-2573
To Purchase, Rent Or Preview, call: 1-800-267-7710
Toronto Area,call: 973-9110

- Service charges for renting videos are $3.00 per day/per video, plus taxes.

Automania
6 min. 1994
0094 052
REVIEWED: An extremely funny, short,animated film demonstrating our dependency on the automobile. Also illustrates all of the alternative methods of transportation available.

The Energy Carol
11 min. 1975
0175 746
An animated spoof of A Christmas Carol in which Ebenezer Scrooge's motto changes from "to waste is to grow" to the conservation conscious "back to basics."

Lord of the Sky
13 min. 1991
9191 093
REVIEWED: A wonderfully animated film combining 3-D models,puppets, cutout-paper and special effects. A strong message about the need for a renewed inter-relationship between the Earth and her inhabitants. Includes native folklore and creative storytelling and the belief that we "only take what we can use."

Protecting Our Planet, Volume 2
56 min. 1992
193C 9192 090
INCLUDES: Run for Your Lives (Austria),The Storks Will Come Back (Portugal),City Parks (Catalonia) and Rumbling Into Our Future (Sweden)
REVIEWED: The short 15 min. film,Rumbling Into Our Future depicts students in Sweden taking action to make a positive change for their environment. The students are filmed making a short animated film about transportation and its effect on the environment and our health. It discusses some alternative approaches and is a good springboard for creative methods to discuss the Greenhouse Effect and transportation.

Room Full of Energy
9 min.43 sec. 1982
10182 509
REVIEWED: An animated film which familiarizes elementary school children with the many different types of energies available, where they come from and how they are made. Also tries to stimulate interest in energy conservation.

A World of Energy 1
69 min. 1981
0181 178
INCLUDES: Energy from the Atom (12:23),Sun, Wind and Wood (24:30) and Tomorrow's Energy Today (31:49)
REVIEWED: The most applicable section is Sun, Wind and Wood - a documentary illustrating how people are using renewable resources to meet their energy needs. Rather long and possibly too advanced, however it is a good visual to present the alternatives to fossil fuels.

A World of Energy 2
48 min. 1985
0185 147
INCLUDES: Harness the Wind (11:48),The Solar House (10:43), Bate's Car: Sweet as a Nut (15:33) and Bill Lossely's Heat Pump (9:52)
REVIEWED: These films discuss the following alternative energies: wind energy, solar heating,manure fuel and ground heat. The Solar House is an animated film which introduces the students to the principles of solar heating for the home. Bate's Car is an interesting film about a man who utilizes his barnyard manure as a solution to a gasoline alternative.

What on Earth!
9 min.35 sec. 1966

10166 033
REVIEWED: A classic animated film that depicts life on Earth as one long, unending conga-line of cars. Martian visitors judge them to be the true inhabitants of Earth,while humans are seen as parasites infesting the cars.

VISUAL EDUC ATIONAL CENTRE (VEC)
(416) 252-5907

Global Warming: Hot Times Ahead? Churchill Films.
23 min. 1990
ages: 14 - adult
Good overview of all of the topics related to climate change. Includes: explanation of the greenhouse, how humans are amplifying the natural greenhouse effect, energy use in the home, car dependency, alternative energy sources, recycling, reduction of CO_2 by planting trees and promotes action. May be too advanced for grades five and six.

LM MEDIA MARKETING SERVICES LTD
115 Torbay Road, Unit 9
Markham, ON
L3R 2M9
tel (905) 475-3750
fax (905) 475-3756

- Videos are loaned free, with a $4.00 shipping fee for the first video, and $1.00 for each additional one. Also videos are returned at teacher's expense.

CAT Public Service Announcements
45064 (VHS) Eng
45065 (VHS) Fre
ages: 8-13 years
REVIEWED: Five 30 second public service announcements on behaviour of Canadians towards energy consumption and alternative energy in cartoon format. Produced by Natural Resources Canada.

Environmental Technology
22 min.
45750 (VHS) Eng
Netherlands technological solutions to environmental problems. Produced by the Embassy of the Netherlands.

Energy in Canada and Remote Communities
Natural Resources Canada.
42487 (VHS) Eng
44251 (VHS) Fre
Solutions to energy needs are found through recent advances in energy efficiency technology.

METROPOLITAN TORONTO LIBRARIES

Earth's Future Climate.
Valencia Entertainment.
27 min.
363.7387/EAR
LOCATION: Scarborough (Morningside).

Global Warming.
Schlessinger Video Productions.
30 min. 1993
363.7387/GLO
LOCATION: Scarborough (Bridlewood and Cedarbrae District).

Greenhouse.
Energy, Mines and Resources Canada.
10 min. 1990
J333.7916/G
LOCATION: Etobicoke.

TV ONTARIO
Client Services
1-800-668-9974

INTERNATIONAL TELEFILM
1-800-561-4300
Mississauga

NOTE: Due to funding cut backs,TV Ontario videos may only be purchased for $39 CDN per episode from International Telefilm. No previewing services are available.

The Green Earth Club series
Aimed at junior level students,TVO has published newsletters to accompany shows with suggested activities, essays and articles.

The Greenhouse Effect episode
(BPN 389229) 1990
14:25 min colour
REVIEWED:Explains the greenhouse effect, and how it affects the environment. Children recite poetry and

explain how to write petitions.

SCOTT RESOURCES INC .
PO Box 2121
Fort Collins, CO
USA
80522-2121
(303) 484-7445
fax (303) 484-8067
1-800-289-9299

The Greenhouse Effect
grade 7-9
17 min
$64.95 US
REVIEWED:Explains the greenhouse effect and how humans have affected it. Also, it explains the carbon cycle, weather patterns and the effects of human activity. Includes suggested action by individuals and industry. Includes a four page teacher's guide, summary of the video, vocabulary list, discussion points and class activities.

Teacher Evaluation Sheet

Name _____

School and School Board _____

Address _____

Telephone _____

Fax _____

Grade Level _____

Date _____

What is your opinion of this resource?

	Excellent	Good	Needs Improvement
Overall Impression:			
Educational Value:			
Ease of Use:			
Appropriateness for Grade Level:			
Motivated the Learner:			
Engaged the Learner:			

1. **Which chapters of the unit did you use?**
   a) Climate Change
   b) School Transportation Audit
   c) Energy Use in the Home
   d) Exploring Energy Source
   e) Consensus-Building
   f) Global Warming around the World

2. **What didn't work well?**

3. **What was the reaction of your students to the exercises?**

4. **Were they able to make the connection between climate change and their daily activities?**

5. **What additional materials did you use?**
(Please attach any additional lessons, and we will credit your name in the next edition).

6. **Do you have any suggestions for improvement?**

Please mail the completed form to:
Toronto Environmental Alliance
122 St. Patrick St., Suite 209
Toronto, Ontario
M5T 2X8
Attn: Samantha Berman