Sustainability
Agriculture &

Let's Go Green!

Sustainable living Project

CANADA

Saskatchewan

4-H MOTTO

Learn to do by doing.

4-H PLEDGE

I pledge
My HEAD to clearer thinking,
My HEART to greater loyalty,
My HANDS to larger service,
My HEALTH to better living,
For my club, my community and my country.

4-H GRACE

(Tune of Auld Lang Syne)

We thank thee, Lord, for blessings great
On this, our own fair land.
Teach us to serve thee joyfully,
With head, heart, health and hand.

This project was developed through funds provided by the Canadian Agricultural Adaptation Program (CAAP). No portion of this manual may be reproduced without written permission from the Saskatchewan 4-H Council, phone 306-933-7727, email: info@4-H.sk.ca . Developed November 2012.

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Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada
AGRICULTURE COUNCIL OF SASKATCHEWAN INC.

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Introduction

In this project, we are looking at the large topic of conservation of the world's natural resources and the protection of our environment.

When we refer to conservation of natural resources, we are talking about protecting or preserving substances like oil, trees or water so that they are not destroyed or polluted. A shorthand way of describing such actions is to call them ***green***. Often ***going green*** means that we are trying to live sustainably, or only use the natural resources that we need so they are still here and available for future generations. So this project will focus on sustainable living and development, or going and living green.

> Sustainable Development – development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
>
> *As defined by the World Commission on Environment and Development in 1987, and endorsed by the United Nations Conference on Environment and Development in Rio de Janiero in 1992.*

Why is this project important? Why should we be green? With the level of consumption in the past and in the present, we may run out of some resources in our lifetime or our children's lifetime. We may also have adversely affected our environment and life as we know it will change.

For example, with the discovery of petroleum and the development of the combustible engine, we have developed a lifestyle dependent on petroleum resources such as coal, oil and gasoline. We use these products to warm our homes, some to cook our foods, to drive our cars and to fuel our industries. However, the concern is that we have hit **peak oil**. This is a theory that we have used most of our oil resources and that we will run out in the near future unless we become serious about conservation. To run out of oil will mean that our lives may change dramatically unless alternatives are found. By conserving, we can make the supply last longer and in the meanwhile, develop alternatives.

Another reason that this project is important is that by using these resources, by-products or wastes are created. Often these have an impact or negative side affect on our air, water, natural environment and possibly our climate. So by conserving our resources and dealing with our waste, we can make the world a better place, and a greener place where we still have natural resources for future generations.

In this project, we learn to do by doing and lead by example.

Objectives

- ✓ To become aware of our use of resources, our impact and why we should be green
- ✓ To develop strategies to reduce our use and impact and how to be green
- ✓ To identify and make changes in our communities making them greener

Achievement Requirements of this Project

- ✓ Completed record book
- ✓ List of at least three tips from each of the units to being more green
- ✓ Calculation of personal carbon or ecological footprint
- ✓ Completed energy audit
- ✓ Item that has been repurposed
- ✓ Water or air audit of your home
- ✓ Item or photo display of garden, compost system or something you made – cheese, pizza, preserves
- ✓ Handmade gift or card
- ✓ Photo display of, or plan for, planting or clean up project
- ✓ Photo display of, or plan for, community green project

Getting the Most from this Project

- ✓ Attend club and project activities regularly
- ✓ Listen and ask questions. You will learn from each other as well as your leader
- ✓ Undertake activities so that you can 'learn to do by doing'

Resources for Learning

- ✓ **People** – members of our communities and beyond can have a lot of knowledge on being green. This includes members of natural history clubs, local conservation groups, government organizations in charge of environment, renewable resources, etc.
- ✓ **Websites** – the Internet is a good source of information, but be wary of the source. Good sources are documented in each section.
- ✓ **Printed information in leaflets, books and magazines** – government offices and libraries are good sources.

Unit 1: The Situation

Dating back to the late 1800s, people have been taking steps to address some of the environmental issues that they have witnessed such as air and water pollution and destruction of natural habitat. These issues as well as depletion of our ozone layer, oil spills and peak oil are with us today. When we are concerned about these issues and take actions to address them, we can call ourselves "green". And as Kermit the Frog says, "It's not easy being green." Through this project, you will find that Kermit was right and he was wrong. Some things are easily done, others are harder. However, Kermit would probably agree that being green feels good!

What are some of the issues we face today?

1. **Dwindling natural resources** – As humans, we have used many of our easily accessed resources, both renewable and non-renewable. Many of our fish stocks such as Atlantic cod and Pacific salmon have been overharvested; many of our large trees have been taken; oil is getting harder to find and extract; and clean water is at a premium.
2. **Global population growth** – The world's population is continuing to grow at about 1.14 per cent a year. This means the number of world inhabitants will double in 61 years. This increase will create an increased demand for resources and energy, which are declining at the same time.
3. **Pollution and waste disposal** – The waste products from resource use are becoming more evident. Lakes and rivers have been polluted, air quality is degrading, and landfill sites are filling up.
4. **Disappearing habitats** – As cities grow and resource extraction takes place, our natural environments are disappearing. Many wild animals depend on natural and wild areas.
5. **Global climate change** – As our resource and energy use increases, we are putting more pollutants into the atmosphere. This may be causing a change in our climate, which could have significant implications.

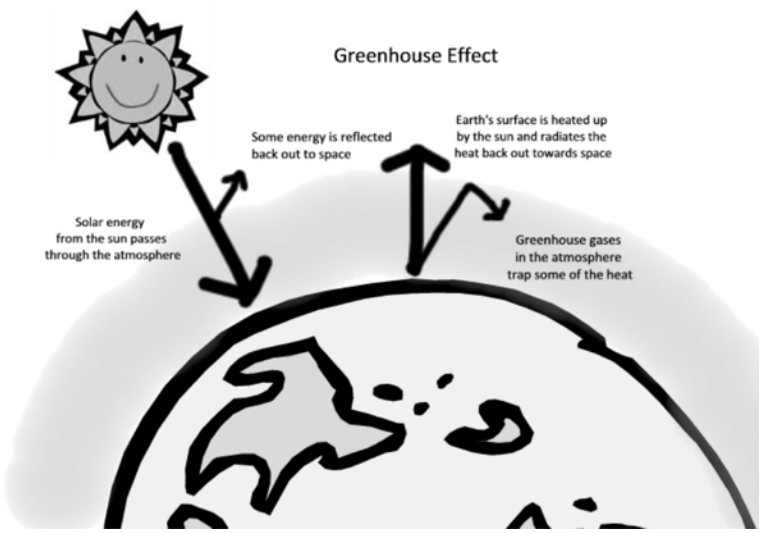
Discussion Points: Can you identify other environmental issues that we are currently facing?

Global Climate Change

Climate change is a global problem with wide-reaching consequences. ***Climate change*** refers to any significant change in temperature, precipitation or wind for a long time. It is not just a few hot days

in a row but is unusual weather that happens for years. Our climate is controlled by the sun; the sun heats our earth but much of the heat bounces back into the atmosphere. Our climate is changing because we now have a layer of gas in our atmosphere that is preventing the heat from escaping. It is like the earth is trapped inside a giant greenhouse – thus, the name ***greenhouse effect*** and the gases that are responsible are called ***greenhouse gases***. This trapped heat is causing our climate to change.

The greenhouse gases (GHG) are carbon dioxide (CO_2), water vapour, methane, nitrous oxide and ozone. We need some of these gases in our atmosphere to keep the earth warm enough to live on. They come from a variety of different sources, both natural and made-made. Water vapour and ozone occur naturally in our atmosphere while methane is generated by decomposing garbage in our landfills and by cattle as they digest their food. Nitrous oxide is produced when plants die and rot, and carbon dioxide is naturally emitted when humans and animals breathe. However, because of our use of fossil fuels, we have drastically increased the amount of carbon dioxide in our atmosphere. The carbon dioxide that is trapped in our atmosphere can stay there for a very long time, up to 1,000 years until it gets taken up by plants as part of photosynthesis.



Climate change can happen naturally, like earth orbiting around the sun. However, scientists are finding that the normal climate change would have happened at a much slower rate, and that human activity, like burning fossil fuels, releases gases that do not allow the heat from the sun to escape. Thus, doing what we are doing – heating our homes, driving cars, watching television – is speeding up climate change.

One of the big concerns of climate change is the effect on the polar ice caps. Scientists have found that they have already begun to melt and will continue to do so. This huge amount of melting ice will cause the ocean levels to increase. As the oceans rise higher and higher, the coastal land where the majority of the world's population lives and works will flood.

Another effect of climate change is an increase in the frequency of extreme weather events. The ice storms, tornados and floods are on the increase, and because we have never seen this type of weather before, it is difficult to predict. The resulting damage is costly.

In addition to extreme weather events, other changes associated with climate change are more gradual. In northern Manitoba, lakes and rivers are freezing later and thawing earlier, making it difficult to build and maintain the ice roads that are vital for many northern communities. Over the past 10 years, the network of these ice roads has gone from 50 to 60 days of usage to as low as 20 days in some years (Statistics Canada). In Interior British Columbia, the mountain pine beetle has enjoyed a series of mild winters. Without cold winters to kill them off, the pine beetles have spread resulting in the death of millions of hectares of pine forests.

How are we doing?

Do you think Canada is a green country? Sure, we have well-insulated homes; we recycle, buy fuel-efficient vehicles and take reusable shopping bags to the supermarket. However, we live in a developed nation, and most developed nations have a high rate of consumption which has a high rate of impact. We have electrical appliances, stereos, TVs, cars, boats, etc. – all of which use energy and resources to make and energy to run. Canada is one of the world leaders in energy consumption, largely due to size of the country, the sparseness of the population, the extreme climate, our resource-based economy and the volume of goods we export. In the winter, we must heat (and some argue overheat) our homes to survive, and with vast distances, we use energy such as gasoline or diesel to travel and transport goods.

According to a Yale University study on the Environmental Performance Index, Canada ranked 37th out of 132 countries and is considered a strong performer on the 22 environmental indicators. Much of this reflects government policy that is somewhat beyond our ability to influence. However, there is a lot we could do.

One critical indicator of our impact is the amount of energy we consume. According to Enerdata (who produces world energy statistics), every Canadian uses 7.82 **tonnes of oil equivalent (TOE)** –

which means our energy use each year is equivalent to burning nearly 8 tonnes of oil! That is also the same as 9,200 litres of oil (2,024 gallons) or 46 bathtubs[1]. That means each year every one of us uses enough energy to drive across Canada 14 times[2]! Each American uses 7.18 TOE and each German, 3.86.

Another indicator is the amount of carbon dioxide gases we produce. Remember that carbon dioxide is a byproduct of energy use and a greenhouse gas. According to Enerdata, every Canadian emits 15.68 tonnes of CO_2 every year. Every American produces 17 tonnes and every German 8.9 tonnes.

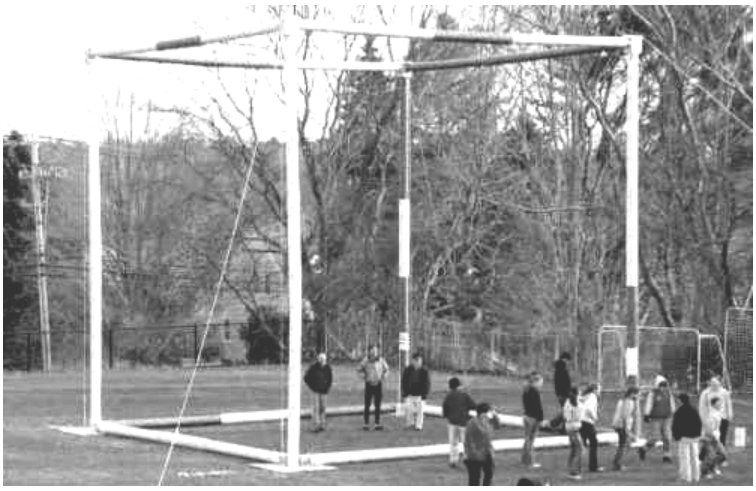


Photo Credit: www.sustainablemilton

What is a tonne of carbon dioxide? Since CO_2 is a gas, a tonne of gas is difficult to visualize. As you can see below, a teacher from Cohasset High School in Cohasset, Massachusetts constructed a model of the size of a tonne of CO_2. It is a cube that is 8.2 metre (27 feet) by 8.2 metre (27 feet) by 8.2 metre (27 feet). Just think, each one of us produces over 15 of those every year.

If we combine that with the other greenhouse gases, each one of us produces 20.3 tonnes. According to Environment Canada, from 1990 to 2005, GHG emissions increased 17per cent, and Canada has about 0.5per cent of the world's population, but contributes about 2per cent of the total global greenhouse gas emissions. This puts Canadians among the highest per capita emitters. Once again, this is a result of our geography, climate and economy.

What Size is Your Footprint?

So how are we as individuals, families and communities doing? How green are we? Everything we do has an impact on the environment. Having a shower, eating our breakfast, taking the bus to school, using paper, heating our homes – all these activities use resources, and all take their toll on the environment.

Various measures have been developed to determine how green we are. The simplest is how much – or how little – energy we are using. Many of our parents would be aware of how much energy we

[1] Assuming a bathtub hold 200 litres of liquid.
[2] Assuming driving a vehicle of fuel efficiency of 8l/100km – like a Ford Focus

use by what they pay for electricity, natural gas and gasoline. However, given that prices change frequently, a better indicator is the quantity we use in terms of kilojoules (kJ) or megawatts (Mw).

More complex measurements are carbon footprints and ecological footprints, which can be calculated for a person, business, city, nation or the world. A **carbon footprint** measures the amount of carbon dioxide we create as we live our daily lives, and therefore indicates our impact towards global climate change. An **ecological footprint** measures the demand for resources which is compared to the ability of the earth to supply those resources. It is calculated by gathering information on how much carbon, food, housing and other resources we use, and the amount of land and water needed to provide the resources and to absorb the carbon that would be produced. The more of the world's resources we use, the bigger our footprint is. Our goal should be to have as small a footprint as possible.

An ecological footprint is based on the concept that we have only one earth and it has limited resources; everyone has to share those resources. If we are taking more than our share that means our lifestyle is not sustainable, or that the world cannot support our lifestyle. If everyone began to use more than their share, we would quickly run out of resources.

According to Global Footwork Network, world populations use the equivalent of 1.5 planets to provide the resources we use and to absorb our waste. This means that given the current use of energy and resources, we are using the earth's resources faster than the earth can reproduce them, and soon we will run out. In fact, if all the other people on earth used as much energy and resources as we do in North America, we would need three to five more earths to support us.

By calculating our ecological footprint or our carbon footprint, we can establish a baseline or a benchmark. Then we can undertake actions to shrink our footprint – like recycling more, increasing our homes' energy efficiency and driving less.

Check out the activity guide to calculate your footprints!

Green Cities: According to a research project undertaken by the Economist Intelligence Research Unit and sponsored by Siemens, a respected global engineering company, Vancouver ranks second out of 82 cities in the United States and Canada in terms of being green. Toronto ranked 9th and Ottawa 12th.

For more information on Vancouver Greenest City, check out https://vancouver.ca/green-vancouver/a-bright-green-future.aspx

Unit 2: Energy Conservation

Canada's energy consumption is large. According to the World Resources Institute, Canada is one of the top ten countries for energy use per person. Yikes! The CIA World Factbook shows that we are the sixth largest consumer of electricity in the world. Only China, the United States, India, Japan and Russia use more. In terms of our individual consumption, we are the third highest consumers of electricity. Only Iceland and Norway beat us.

Generally, energy use is related with the market values of all the products or services of a country, or their ***Gross Domestic Product (GDP).*** Canada has a fairly high GDP; we supply a lot of products and services. We also have a cold climate and vast distances so we need more energy to keep warm in winter and get to our closest town or city. Both of these increase our energy use compared to smaller warmer countries.

Energy use is measured in joules, and the movement of energy is measured in watts. A 54 gram Mars bar contains just over 1,000,000 joules of energy; if converted to electricity, the energy contained in this chocolate bar would operate a 60 watt light bulb for 4.6 hours. When talking about larger quantities of energy and energy use, kilojoules, megawatts or even petajoules and gigawatts are used. Our national energy use is measured in petajoule (pJ), which is 1,000,000,000,000,000 joules, or a LOT of Mars bars!

Units of energy

Energy is measured in units known as joules (J). Since a joule is a relatively small amount of energy, we talk about energy consumption in terms of: gigajoules (1x 10^9J or 1,000,000,000 J), indicated by GJ; terajoules (1x10^{12}J or 1,000,000,000,000 J), indicated by TJ; or petajoules (1x10^{15}J, indicated by pJ. Here are some interesting facts:

- 4,184 J are required to raise the temperature of 1 litre of water by 1°C.
- The propane cylinder found on most propane BBQs holds approximately 9 kilograms of propane, which is roughly 0.45 GJ of energy.
- 1 GJ is equal to slightly more than 2 propane cylinders like the ones used on most gas BBQs.
- The energy content of a 30 litre tank of gasoline is about 1 GJ.
- 1 TJ is equal to slightly more than 2,200 propane cylinders.
- 1 railway tanker carrying propane contains about 113,000 litres of propane, which is about 3 TJ of energy.

According to Canada's Office of Energy Efficiency of Natural Resources Canada, industry uses the most energy at 3,168 petajoule (pJ), which is twice as much as residential at 1,422 pJ and is the next highest user. Next is transportation of passengers (as opposed to freight) at 1,317 pJ of which cars account for 50 per cent of that. Over the last 20 years, residential energy use has risen 11 per cent and industrial use has increased 37 per cent.

Table 1: Energy Use in Canada

Use	Petajoules	% of total	% change in 20 years
Industry	3,168 pJ		+37.0
Residential	1,422 pJ		+11.0
Space heating		62.8	+12.7
Water Heating		17.3	+0.5
Appliances		14.4	+11.9
Major appliances			-16.0
TVs, video recorders			+158.0
Lighting		4.3	+17.8
Cooling		1.2	+67.8
Transportation (passengers)	1,317 pJ		
Private cars		50	

As you can see from the above table, most of the energy used in homes goes to heating our homes, which is not surprising given the length and coldness of winters here in Canada. All types of energy use in our homes have gone up except for major appliances. This might be because they have become more energy efficient, or that they are being used less. However, this saving is offset by minor appliances like home entertainment, TVs and computers which have gone up a whopping 158 per cent! Cooling our homes is also up a dramatic 68 per cent. It is important to keep in mind that our use of energy – particularly burning fossil fuels such as oil, natural gas and coal – is directly correlated is the production of greenhouse gases like carbon dioxide (CO_2). So as our electricity use goes up, so do our emissions of greenhouse gases.

We as individuals can address at least two of these big energy uses – residential and transportation – lower our energy use, reduce our ecological footprint and become greener. The Activity Guide will outline some projects for you to first determine your energy use, and then how to address it.

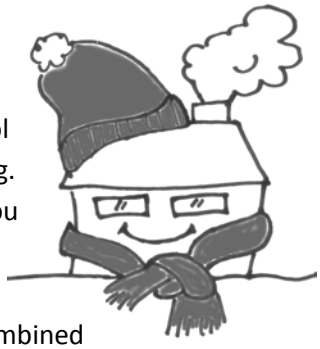
In Our Homes

As reported above, heating our homes and our water are big uses of energy. We as individuals can take steps to reduce our use, and help others to decrease theirs.

At its most basic, our homes are a big box that protect us from the weather and maintain a comfortable temperature throughout the year. Two components – the building enclosure and the

heating system – are at the heart of what make our homes operate efficiently while providing maximum comfort.

In Canada, our houses serve to hold the heat in during the winter and to keep it out in the summer. Interestingly, heat will move wherever there is a difference in temperature. That means that heat flows from areas of warmth to areas of cold. That might be up to the ceiling and attic, or out the walls and windows to the outside, or down to the floor and basement.



The best way to keep heat in in the winter or out in the summer is to have good insulation and air barrier, which can be combined with a vapour barrier. A well-insulated house is like dressing for the weather. A wool sweater will keep you warm if the wind is not blowing and if it is not raining. On a rainy day, wearing a nylon shell over your wool sweater helps to keep you reasonably dry and warm, and on a rainy day, a gortex jacket will help keep you mostly dry. In terms of a house, the wool sweater is the insulation, the nylon jacket is the air barrier, and the gortex jacket is the combined air barrier and vapour barrier.

Insulation and air barriers will do a lot for keeping the heat where we want it, but air leaks can affect how comfortable our homes are. An air leak would be like having a rip in your nylon jacket. When the weather is warm, we feel quite warm; but if the weather is cold, that rip lets in a lot of cold air! Air leaks can waste a lot of energy which can cost the homeowner money in terms of energy use, and increase their greenhouse gas emissions. Some of the quickest energy and money-saving tasks we can do is to caulk, seal and weather strip all the seams, cracks and openings to the outside.

Insulation effectiveness is measured by R values (or RSI values which is the metric equivalent). The higher the R value, the more resistance the material has to the movement of heat. The different provincial building codes specify a minimum R value for new construction. Insulating, or re-insulating an existing building is trickier as getting at the walls and repairing them can be costly. Insulation can be blown into the walls or a new wall built inside and insulated as a new wall. One of the most cost-effective places to add insulation is the attic. The right insulation system can save the homeowner money, reduce the amount of energy that is used, make the home more comfortable and be greener.

These websites have some good information for improving insulation and air barriers.

- http://www.cmhc.ca/en/co/maho/enefcosa/enefcosa_002.cfm
- http://energy.gov/sites/prod/files/energy_savers.pdf

Or check the Natural Resources Canada publication, *Keeping the Heat In* that is available on their website:

- http://oee.nrcan.gc.ca/sites/oee.nrcan.gc.ca/files/files/pdf/residential/personal/keeping-heat-in-e.pdf

You can assist your parents and other homeowners by becoming an Energy Sleuth – check out the Activity Guide.

Heating and Cooling

In Canada we need to actively heat, and sometimes cool, our homes. Heating and cooling use the most energy and cost more money than any other system in our homes.

A wide variety of heating and cooling systems are available from high-efficiency furnaces to wood-burning stoves to heat pumps. Regardless of the kind of system, we can reduce our energy use and our ecological footprint and, be green by properly maintaining and upgrading our equipment. Combined with insulation, air sealing and thermostat settings, we could cut our energy use and decrease environmental emissions by 20 to 50 per cent. Now, that's going green!

Hot Water Heating

Heating our water is our next biggest use of energy in our homes. Basically there are four ways to be greener, cut your water heating bills and reduce your footprint:

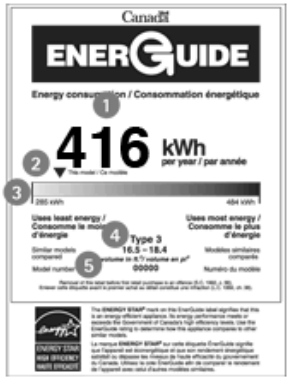
1. Use less hot water.
2. Turn down the thermostat on your water heater to 60°C (Note that a lower temperature might promote bacterial growth).
3. Insulate your water heater.
4. Buy a new, more efficient water heater.

Discussion Point: How can you use less hot water?

Appliances

Every electrical appliance has two costs – the one on the price tag in the store and the one on the utility bill. For some energy-wasting appliances, the cost to run it may be many times greater than the cost to purchase it. Some of the energy efficient ones may have a higher price tag; they often pay for themselves in energy savings.

Two types of labelling are available to help you select energy efficient appliances and products. First is the EnerGuide. In Canada, all new electrical appliances manufactured in or imported into Canada are legally required to have an **EnerGuide** label that indicates the amount of electricity used by that appliance. This information is determined by standardized test procedures and is verified as meeting Canada's minimum energy performance levels by a third-party agency.



The EnerGuide label contains the:

1. Average annual energy consumption of the appliance in kilowatt hours (kWh).
2. Energy efficiency of the appliance relative to similar models.
3. Annual energy consumption range for models of this type and size.
4. Type and size of the model.
5. Model number.

Second is the international **ENERGY STAR®** logo. It is displayed with the EnerGuide label, or separately. It identifies major electrical appliances that meet or exceed technical specifications designed to ensure that they are among the most energy efficient in their class without compromising performance. In Canada, the ENERGY STAR® symbol is used to rate at least 40 types of products, including six types of major electrical appliances such as clothes washers, dishwasher, dehumidifiers, freezers and refrigerators. The ENERGY STAR® rating ensures the product is among the most efficient in its class whereas the EnerGuide rating tells you how much energy it will use.

The U.S. Department of Energy estimated that if one in 10 American homes used only appliances endorsed by the Energy Star program, the reduction in U.S. carbon emissions would be the same as planting 688,000 hectares (close to 1.7 million acres) of trees – an area just larger than Prince Edward Island! That's a lot of trees!

Lighting

Over four per cent of our energy use is lighting. Just switching to energy efficient lights such as CFLs (compact florescent lamps) and LEDs (light-emitting diodes) is one of the fastest ways to cut our energy use. Timers and motion sensors save us even more electricity by reducing the amount of time lights are on but not being used.

As with appliances, every lighting product we buy has two prices – the purchase price in the store and the operating price. This second price may not be obvious but it may be significant depending on the energy our new fixture or light bulb will consume. We can think of the purchase price as a down payment and the ongoing operating costs as a series of monthly installments we must pay until the unit is replaced. For example, a 60 watt incandescent bulb we buy for 50 cents can cost us

another $4.90 in electricity before it has to be replaced. Since the second price tag will cost additional money, we should consider it when we make a purchase decision.

According to the Energy Efficiency Office of Natural Resources Canada, a typical house has 30 light bulbs that use about $200 worth of electricity each year. By replacing light bulbs you use the most with ENERGY STAR® labelled CFLs, you can reduce annual emissions associated with your lighting needs by 72 kilograms per year. If every household in Canada changed just one traditional incandescent light bulb to an ENERGY STAR® labelled CFL, the country would save over $73 million in energy costs every year, and reduce greenhouse gas emissions by 379,000 tonnes of carbon dioxide. This would have the same impact on climate change as taking 66,000 cars off the road for one year. See how individual actions, when added together, can make a big difference.

Check out the table below for energy efficient lights bulbs. In general, these bulbs cost more than tradition incandescent bulbs but, they use less energy and last longer too.

Energy Saving Light Bulbs

Halogen

- Energy efficient incandescent bulbs.
- Last up to three times longer than traditional light bulbs.

Compact Fluorescent Lamps (CFLs)

- Last about ten times longer and use about one-fourth of the energy of traditional incandescent bulbs.
- Can last five years with three hours of use a day.
- Typically pays for itself in energy saving in less than nine months.
- Contain a very small amount of mercury and require special handling if they are broken, and should be recycled at the end of their lifespan.

Light-Emitting Diodes (LEDs)

- Rapidly expanding in household use.
- Use only about 20-25 per cent of the energy.
- Last up to 25 times longer than traditional bulbs.

With the advancements in lighting, we need to start shopping for light bulbs based on how much light they provide instead of how much energy, or watts, they use. A ***lumen*** is a measure of brightness of a light bulb, so the higher the number of lumens, the brighter the light bulb. If you want to replace an old 100 watt bulb, look for an energy saving bulb that puts out 1600 lumens; to replace a 60 watt equivalent, look for a bulb with 800 lumens.

Discussion Point: How many energy-saving light bulbs to you have in your home? Can you identify high-use areas where you could replace traditional bulbs with energy efficient ones?

Energy Vampires

No, this isn't another sequel to the famous *Twilight* series or the addition of another character to Belle and Edward. ***Energy vampires*** are lurking everywhere, sitting and waiting. If the fangs of your cell phone charger are plugged into an outlet with your phone attached, you have an energy vampire. If your computer is hiding in the cloak of darkness in "standby mode", it becomes an energy vampire. An energy vampire is something that is quietly sucking electricity that seeps from your home's outlets. It can be any appliance that displays a clock like a microwave oven, coffee maker or a DVD player; it can be any item that trickles charges even after the device is charged at capacity like cell phones, toothbrushes or portable tools; it can be anything with a remote control that uses standby power and that has a standby light like televisions, DVD players or stereos.

A growing number of household electrical devices are designed to draw power 24 hours a day, seven days a week. Even when turned "off", these items continue to use electricity to operate features such as clocks, timers, touch pads or are on standby to receive signals from remote controls. Battery chargers draw power when they are plugged in – even if the device they power is fully charged or disconnected. The only way to guarantee that an electronic devise is not drawing power is to unplug it from the outlet.

Although the standby power consumption of most devices is relatively small and varies from 0.5 to over 25 watts of electricity, we are concerned about the accumulative effect, or the effect of all these uses combined. The average North American home has about 40 appliances sucking power and the number of devices we have that do this is growing. According to the Office of Energy Efficiency of Natural Resources Canada, five to 10 per cent of the electricity consumed in the average Canadian home is used to power appliances and home electronics while these devices are on standby. Collectively this adds up to at least 6.3 terawatt hours (6,300,000,000 kWh), which is more than the residential electrical consumption of New Brunswick!

Even more astounding is that with the increase of electronics and other appliances that have standby lights, the percentage of electricity used to power energy vampires in our homes could increase to 20 per cent in the near future. We should be particularly concerned if we live in an area where our electricity is produced by coal-fired power plants, which is a significant contributor to CO_2 emissions and air pollution. These energy vampires contribute to our ecological footprints

needlessly and are certainly not green. The Energy Analysis Department at the Lawrence Berkeley National Laboratory estimates that vampire energy accounts for one per cent of the world's carbon dioxide emissions. That's equal to the combined annual production of dozens of power plants in the United States alone – and that's a lot!

The top five users

- **Television** – a hungry Plasma TV uses 1,400 kilowatt hours annually, or $165*!
- **Video Games** – use 230 kilowatt hours, or $25/year
- **Laptop** – use 127 kilowatt hours, or $15/year
- **DVD Player** – 78 kilowatt hours, or $8/year
- **Cell Phone Chargers**

* This is based on 11.8 cents per kilowatt-hour

To battle this problem, the state of California passed legislation last year nicknamed the "Vampire Slayers Act" that will add vampire electronics labels to consumer products. These labels will show how much energy a charger, computer, DVD player, microwave or TV uses when on, off or in standby mode. With this type of information, we the consumers can make good informed and greener choices.

Discussion Point: How many energy vampires do you have in your house? What can you do to reduce the amount of energy sucked out by these vampires?

Smart Meters

Smart meters are a new introduction by our power companies that provide two-way communication between our homes and our power or utility company. This allows the company to manage power use so that they can meet demand for power and provide a reliable electrical service. If our utility company can manage demand at peak times, they don't have to look for other sources of power such as building another hydropower dam, or burn more coal in their coal-powered generator. That's better for the environment and helps with our ecological footprint. It's a green move!

We can use this technology to save energy, money and be greener. By displaying our home energy use and providing accurate up to date information, smart meters can help us reduce our power use, or change when we use our power to off-peak. These meters will even allow us to remotely turn appliances off or adjust our thermostats. Through smart meters, we can install solar panels or other clean sources of power and sell excess power back to our utility company.

Some manufacturers are now offering **smart appliances** – appliances that can be connected with home energy management systems to help us shift our electricity use to off-peak hours. They don't just suddenly turn off during times of peak electricity demand, but they subtly shift electrical use so that we might not even be aware of it. Fox example, your refrigerator might delay its defrost cycle until the middle of the night, or our air conditioners may run slight less often during peak demand times.

In Our Cars and Trucks

Transportation comes in a close second to residential in terms of our overall energy use. Private cars account for half of that use, and vehicle use is growing.

Canada has over 1.4 million kilometres of road, 35 per cent of which is paved. We have 17,000 kilometres of expressway, which is the third longest in the world behind U.S. and China. According to Statistics Canada, almost 21 million road vehicles were registered in Canada in 2009. Ninety-six per cent of those were less than 4.5 tonnes and they travelled 303.6 billion kilometres. Given the data available from the Office of Energy Efficiency, we can assume that 76.8 per cent of that was done by passenger vehicles including cars, trucks, buses and motorcycles. That means that we drove 236.8 billion kilometres. That's like going to the moon and back 308,813 times, or 846 times every day of the year!

A motor vehicle is quite energy-inefficient just the way it is designed. According to Energy Efficiency and Renewable Energy in the U.S. Department of Energy, only about 14 to 26 per cent of the energy from the fuel we put into our tanks is used to move our cars down the road.

What the rest of your fuel is used for…

68% Engine and driveline inefficiencies such as waste heating, friction, pumping air into and out of the engine, transmission.

17% Idling.

5.8% Overcoming inertia or braking loss, the energy needed to move forward is directly related to its weight. Every time the brakes are applied, the energy initially used to get the car moving is lost, and more energy is needed to move the car forward again.

4.2% Rolling resistance, or the force necessary to move the tires forward. Is related to the weight of the load supported by the tire.

2.6% Aerodynamic drag, the energy used to move air out of the way as the vehicle goes down the road.

2% Accessories such as air conditioning, power steering, windshield wipers.

By using the information from the above table, we can save fuel by considering our losses. The biggest user of engine and driveline inefficiencies is up to the engineers; maybe that's why newer cars have better gas mileage as technology advances. What can we do? We can select an aerodynamic, sleek car made of lightweight materials. We can also change some of our behaviours to reduce our fuel consumption, reduce our emissions and contribute to being green. Many of these will also lower our costs – another benefit to being green! Here are some ideas:

- ✓ **Avoid unnecessary idling** – Today's vehicles warm up fast; idling can use from one to two L/h. It only takes a few seconds worth of fuel to restart your vehicle. So if you are going to idle for more than 10 seconds, turn off your car. Turning your engine off and on, however, may increase ignition wear, but the energy you would save by not idling more than pays for the wear and tear.
- ✓ **Anticipate traffic** – Keep your speed as steady as possible by reading the road ahead, anticipating road disruptions, monitoring the movements of pedestrians and other vehicles, and keeping a comfortable distance between your vehicle and the one in front of you. These driving techniques avoid unnecessary fuel consumption and limit the additional wear on your brakes and tires. Over the course of a year, the savings for fuel-efficient drivers can range from five per cent to over 25 per cent.
- ✓ **Maintain a steady speed –** Be consistent. Unintentional dips in speed and sudden bursts of acceleration to keep pace take a toll on your tank — which takes a toll on your wallet and the environment. In fact, tests have shown that varying your speed up and down between 75 km/h and 85 km/h every 18 seconds can increase your fuel use by 20 per cent.
- ✓ **Keep within the speed limit** – All vehicles lose fuel economy at speeds above 80 km/h. For every eight km/h above 80 km/h it is like paying another 36 cents per litre more. (based on a price of $1.40/l). Most cars, vans, SUVs and pickup trucks have a **sweet spot** between 50 and 80 km/h where they operate most fuel-efficiently. Above this optimal speed zone, vehicles consume increasingly more fuel the faster they go. By avoiding high speeds and driving at a speed within your vehicle's sweet spot you may save on your gas bills and reduce the CO_2 emissions produced by your vehicle. For example, at 120 km/h, a vehicle uses about 20 per cent more fuel than at 100 km/h. On a 100-km trip, this spike in speed — and fuel consumption — would cut just two minutes from your travel time, and if it cost ten dollars-worth of fuel to drive that distance at 100km/l, it would cost 12 dollars to travel that same distance at 120 km/h. That is like throwing a toonie out the window every 100 kilometres.
- ✓ **Accelerate gently** – The harder you accelerate the more fuel you consume. In the city, you can conserve fuel by easing onto the accelerator pedal gently and gradually. To maximize your fuel efficiency, take five seconds to accelerate your vehicle up to 20 km/h from a stop. You can conserve up to 15 per cent of fuel by easing the gas pedal gently and gradually. Just imagine that there's an egg under your pedal and an open cup of coffee on your dashboard. Be careful not to break the shell or spill the drink!

- ✓ **Use less air conditioning** – Air conditioning increases a vehicle's fuel consumption from 13 per cent up to 21 per cent. Instead of using air conditioning or opening the windows (which increases the drag), use flow-through ventilation. If that's not cool enough, select the re-circulate setting instead of the fresh-air option to help minimize the impact of air conditioning on your fuel consumption.
- ✓ **Eliminate extra wind resistance** – Using a roof rack increases the bulk, and therefore, drag of your vehicle. Depending on the shape of the roof rack and the items if carries, the resulting aerodynamic drag can increase fuel consumption by as much as 20 per cent. Streamline your vehicle and carry the load inside your vehicle if you can, or remove the roof rack when not needed.
- ✓ **Remove extra weight** – By reducing extra weight such as sports equipment or sand, you decrease the fuel required to move the vehicle forward. An extra 50 kilograms could reduce your fuel efficiency by two per cent. If you own a small vehicle, carrying extra weight will have a bigger effect that if you drive a larger vehicle. In any vehicle, the less weight your carry, the less fuel your engine will need, and the fewer greenhouse gas emissions your vehicle will produce.
- ✓ **Keep your vehicle well-maintained** – A clean air filter and well-inflated tires can increase fuel efficiency by 13 per cent. You should check your tire pressure monthly. Driving on tires that are underinflated by 8 psi (56 kPa) can reduce the life of your tires by 10,000 kilometres and increase the vehicle's fuel consumption by four per cent. With proper tire maintenance, the average Canadian driver can save two weeks' worth of gas each year, lower carbon emissions and reduce the demand for new tires and landfill space for the old ones. The recommended tire pressure for your vehicle is on the tire-information placard — located on the edge of the driver's door or doorpost—or in the owner's manual. Learn more about tire maintenance at www.betiresmart.ca.
- ✓ **Use your fuel-consumption display** – You can see the impact of using the fuel-efficient driving techniques first hand with the help of a fuel-consumption display. This feature is now standard in many vehicles but if your vehicle doesn't have one, you can easily get one installed if your vehicle was manufactured after 1996. Many drivers consume 15 per cent less fuel by using the feedback that fuel-consumption displays provide.

According to the Office of Energy Efficiency in Natural Resources Canada, if all drivers in Canada practiced fuel-efficient driving we could prevent six million tonnes of carbon dioxide from entering the atmosphere, save 2.6 billion litres of fuel and approximately $2.6 billion in fuel costs!

Buying Vehicles

Selecting and purchasing a vehicle is a big and often expensive decision. As some of us hold on to our vehicles for at least a year, here are some things to consider when making a choice:

- ✓ **What do to you and your family need?** – Do you really need a SUV? A typical SUV uses almost twice the fuel and releases nearly twice the emissions as a car that seats the same

number of people. According to BC Hydro, the 17 million light-duty trucks (SUVs, passenger vans and pickups) on the road in Canada are responsible for about 15per cent of Canada's total carbon dioxide emissions. So if you live and drive in the city, a smaller hybrid might be right for you because they get better mileage in city driving and are easier to park. If you need a vehicle for towing or heavy use, consider a clean diesel vehicle. Diesel engines are quieter, more powerful and 30 to 35 per cent more efficient than similar-sized gasoline engines. The new generation of diesel vehicles meets the same emissions standards as gasoline vehicles so are cleaner than their predecessors.

- ✓ **What are the lifetime costs?** – As with light bulbs and appliances, the sticker price of a vehicle is only part of what you will pay over its lifetime. You need to factor in how much you'll pay in monthly fuel bills and maintenance. You can use the EnerGuide label that is on new vehicles sold in Canada. This details a vehicle's city and highway fuel-consumption rating and the cost of fuelling the vehicle each year. The EnerGuide label can also be used to compare fuel efficiency of different vehicles. At the end of your analysis, you might find that spending more up front will provide more efficiency and durability over the long term.

If you or your parents are looking at purchasing a used vehicle that does not have the EnerGuide label, you can check out the ratings on the Natural Resources Canada website: http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm

- ✓ **Manual or automatic – which is better?** As a general rule, manual transmissions are more efficient than automatic. If you do drive an automatic, choose one with more gears.
- ✓ **What about emissions?** A variety of low-emission vehicles are now available. Many vehicles are rated in terms of their emissions, from low (LEV) to ultra-low (ULEV) to super-low (SULEV). Before buying, compare the ratings to determine your most environmentally-friendly choice.
- ✓ **What about alternative fuels?** Most of the vehicles are currently fueled by **fossil fuels**, that is, gasoline and diesel. The supply of these fuels are diminishing so higher efficiency vehicles such as natural gas and electric or hybrid vehicles, and **alternative fuels** such as ethanol, methanol, blends of ethanol with gasoline have been developed. Depending on your driving need, electric and hybrid cars or those that run on alternative fuels may be an

option. Some of these technologies are still relatively new and may be more expensive; however, their efficiency, low emissions and low noise (in the case of electric and hybrid vehicles) offer advantages.

Into the Future – Alternative Fuels

Biofuels are fuels from renewable sources and are a growing form of bioenergy in Canada. In 2010, Canada accounted for two per cent of world ethanol production and one per cent of world biodiesel production. This is the fifth highest in the world after the U.S., Brazil, the European Union and China). Ethanol is an alcohol and a gasoline substitute and is made from corn, wheat and barley of which Canada is a major world manufacturer and exporter. **Biodiesel** is a diesel substitute that can be made from vegetable oils and animal fats.

In 2010, approximately 1,400 million litres of ethanol and about 139 million litres of biodiesel were made in Canada. The federal and provincial governments have introduced regulations on renewable fuels content that will result in an increase in production and use of biofuels in the coming years.

The final thing you can do to help with consumption of non-renewable fuels and greenhouse gas emissions is to take your junker off the road. On average, older cars emit 19 times as much pollution as cars newer than 2004. Check out this website: Retire Your Ride http://www.ec.gc.ca/education/default.asp?lang=En&n=343C9FDB-1

Alternative Energies

Most of our energy comes from fossil fuels or hydroelectricity. As non-renewable resources such as fossil fuels become scarcer, we are looking to either alternative or renewable energy sources to provide us with what we need. In choosing and developing a renewable energy system, we need to keep in mind that there is often an impact, or a downside, to anything we do. For example, although hydropower is a renewable energy, large areas are flooded to create a reservoir of water to run through the turbines to create the power. This electricity then needs to be transported by transmission lines that remove land from cultivation and create a hazard for migrating birds.

Hydroelectricity is by far the most important form of renewable energy produced in Canada. Other sources are bioenergy, wind, solar, geothermal and tidal energy. In the case of wind and solar, we would be harnessing an inexhaustible supply – the wind will blow and the sun will shine regardless of what we do. Without the burning of fossil fuel, we will have cleaner air, produce less carbon dioxide and be greener!

Hydroelectricity

To produce **hydroelectricity**, the flowing water is directed at the blades of a turbine, making it spin, which in turn, causes an electrical generator connected to the turbine to spin and generate electricity. The amount of energy extracted from flowing water depends on the volume of water and its speed. Usually, a hydroelectric station is built at a sharp incline or waterfall to take advantage of the speed gained by the water as a result of gravity. In some locations, dams are built to help regulate the flow of water and, therefore, the electricity generation.

Hydroelectric stations have been developed in Canada where the geography and hydrography were favourable like Quebec, British Columbia, Newfoundland and Labrador, Manitoba, and Ontario. In 2010, Canada had 529 hydroelectric stations. Together they generated 348 million megawatt hours in 2010 which accounted for 59 per cent of our total electricity generation (Natural Resources Canada). Canada is the third largest producer of hydroelectricity in the world.

Bioenergy

Bioenergy uses biomass, which is a biological material in solid, liquid or gaseous form to generate energy. The most commonly used type of biomass is wood, often waste from industrial activities, which are burned to produce heat used for a variety of purposes such as industrial uses, for space and water heating, or to create steam for electricity generation.

Another bioenergy source that we will cover in Unit 3 Waste is methane. Through anaerobic digestion, methane can be produced from solid landfill material or other biomass materials such as sewage, manure and agricultural waste. As we just covered, transportation fuels like ethanol can be made by distilling sugars extracted from agricultural crops.

Currently, bioenergy is the second most important form of renewable energy in Canada. In fact, biofuels and renewable waste represent 4.4 per cent of Canada's total primary energy. At the end of 2010, Canada had 61 bioenergy power plants which could produce 1,700 megawatts (Natural Resources Canada). Most of these facilities used wood biomass, waste from the pulping process and landfill gas. In 2010, 8.3 gigawatt hours of electricity were generated using wood refuse and pulping waste. Most of the biomass-fired capacity was found in provinces with significant forestry activities: British Columbia, Ontario, Quebec, Alberta and New Brunswick.

Wind Power

Wind energy involves harnessing the power of the wind. It has been used for centuries to propel sailing vessels and turn gristmills and water pumps. Increasingly, wind is used to generate electricity today. Turbines with large propellers are erected on 'wind farms' located in strategic

areas that have good wind and that are close to existing electrical grids. Wind energy is generated only when the wind speed is sufficient to move the turbine blades. The spinning blades send energy to the turbines' generator, where it is transformed into electricity that can be used in our homes. One wind energy turbine can produce enough energy for 400 homes a year.

Canada has large areas with excellent wind resources and therefore a significant potential for the expansion of wind-generated power. Installed wind power capacity in Canada has expanded rapidly in recent years and is predicted to grow at a rapid pace due to increased interest from electricity producers and governmental initiatives. In 2011, Canada had 3,094 wind turbines operating on 152 wind farms for a total installed capacity of 5,265 megawatts, compared with only 60 wind turbines, eight wind farms and 23 megawatts in 1997. The provincial leaders in wind power capacity are Ontario, Quebec and Alberta.

The energy generated from the wind is approximately the same as the energy used if all Canadian families watched television for two hours and 33 minutes[3].

Solar Power

Solar energy utilizes the power of the sun, which will never run out. The energy from the sun comes in two forms – light and heat. Historically, solar energy has been harnessed through passive solar technologies that take advantage of the sun for lighting and space heating. Typically, these involve the strategic location of buildings and various elements of these buildings, such as windows, overhangs and thermal masses. However, this approach to solar energy can be harnessed only during the day and only if the sunlight is not blocked by clouds, buildings or other obstacles.

Today, two active solar technologies that involve electrical or mechanical equipment are becoming more common. First, **solar collectors** or panels are used to heat water or ventilation air for use in buildings. Second, **solar photovoltaic technology** uses solar cells to convert sunlight directly into electricity.

The potential for solar energy varies across Canada. The potential is lower in coastal areas due to increased cloud coverage, and is higher in the central regions. About half of Canada's residential electricity requirements could be met by installing solar panels on the roofs of residential buildings. As yet, solar technology is still expensive to install, particularly photovoltaic systems. As the technology improves and becomes cheaper, and as utility companies are more willing to buy surplus power that is generated, we can anticipate that more of our energy needs will be met by this source.

[3] Based on 34.4 million Canadians, with the average family of three, watching a 40-inch LCD television which uses 180 watt-hours.

Canada's use of solar energy has increased in recent years, although it makes a relatively small contribution to overall supply. Installed capacity for solar thermal power has seen average annual growth of 9.5 per cent since 2000, reaching a capacity of 819 megawatts of thermal power in 2011. This is roughly the same amount of energy as if every Canadian family watched 24 minutes of television. The 2008-11 period was marked by the exponential growth of installed capacity for solar photovoltaic power with the annual growth rate of 147.3 per cent and reaching 495 megawatts. This would provide 14 minutes of television viewing for all Canadian families.

Geothermal Power

Geothermal energy can be captured from the heat stored beneath the earth's surface or from the absorbed heat in the atmosphere and oceans. In the first instance, geothermal energy can be captured from naturally occurring underground steam and used to produce electricity. In the second instance, heating and cooling can be achieved by taking advantage of the difference in temperature between outside air and the ground or groundwater.

In terms of geothermal energy to produce electricity, the highest temperature geothermal resources are located in British Columbia, Northwest Territories, Yukon and Alberta. Heat and power generation projects are being considered in these areas with the South Meager project in British Columbia being the most advanced geothermal power project in Canada.

The second type of geothermal is generally expensive to install but is becoming more popular as technology improves. In 2010, over 95,000 ground-source heat pumps had been installed which could produced an estimated 1,420 gigawatt hours equivalent annually (Natural Resources Canada). This is roughly equivalent to the energy used if every Canadian family watched 32 weeks of television[4].

Ocean or Tidal Energy

Energy of ocean waves and tides can be converted into electricity or other useful forms of power, but the technology to do so is still in development.

Being landlocked only along its southern border, much of Canada is surrounded by oceans, meaning it has access to a significant energy potential. Currently, Canada has a tidal power plant in Nova Scotia with a generating capacity of 20 megawatts of electricity, which is roughly equivalent to Canadian families watching 30 seconds of television. Wave and tidal current technology demonstration projects are underway in British Columbia and Nova Scotia. In British Columbia, the wave energy device has capacity of 100 kilowatts and the four megawatt project in Nova Scotia will be the first deployment of commercial-scale tidal turbines in Canada.

[4] Based on 34.4 million Canadians with average family size of three, watching an average of 21.4 hours of television per week on a 40-inch LCD TV.

Discussion Points:

- If a 20 megawatt generation project produces enough energy for every Canadian family to watch 30 seconds of television, how much television viewing can be powered by 100 kilowatts (0.1-megawatts) and four megawatt projects?
- Does any of your energy come from alternative energies? Does your utility company use any alternative energy to power electricity?

Unit 3: Waste Management

Waste is really just the material that is left over, rejected or thrown away from anything we do be it working, playing or eating. Quite simply it's material that is not wanted by its producer. To many people waste is known as trash, rubbish or garbage.

Managing waste has always been a problem, but particularly since the Industrial Revolution in the 1800s which marked the introduction of power-drive machinery and the manufacture of consumer goods on a large scale. For a long time, wastes were dumped wherever it was convenient – released directly into waterways or freely emitted into the air. We have come a long way since then; we now take steps to control, collect and manage our wastes and have cleaned up streams and land that had been polluted by past waste dumping.

Land Fills – An Urban 'Solution'?

In urban areas, household waste or garbage is taken to **landfills** which are large areas of land or excavated sites that are designed to isolate the garbage from the surrounding area. The landfills have a bottom liner to stop run-off or leachate from seeping into the soil and groundwater. Each day, the landfills are covered with soil and compacted with big machines in order to keep garbage blowing around communities. However, garbage needs sunlight, air, temperature and water to break down. By their nature, landfills don't allow that. The daily application of soil on the collected garbage cuts off sunlight and air and water is kept from entering the landfill through a process called **capping** that seals off water from entering the landfill. As a result, items in a land fill decompose at a much slower rate.

Just the Facts Ma'am

In 1973, an archaeologist named William Rathje undertook the Garbage Project and dug through landfills in Arizona looking for clues to consumer behaviours. In landfills from the 1950s he found whole hot dogs and bags of leaves that looked like they had been thrown away yesterday!

Here's how long some items take to break down in a landfill:

- **Apple core** – from a couple of months to years.
- **Newspaper** – between 2 to 4 months or sometimes years.
- **Cigarette butt** – at least one to five years (and then there's the toxic substances in the filter!).
- **Plastic bottles made of polyethylene terephthalate** (PET – a petroleum-based product) – up to 500 years.
- **Styrofoam** (expanded polystyrene) cup – does not show any sign of breaking down!

Canadians produce approximately 31 million tonnes of garbage a year, 70 per cent of which goes to one of over 10,000 landfill sites. Only about 30 per cent of this waste is diverted by composting, reusing or recycling but Statistics Canada estimates that between 50 and 60 per cent of the waste that goes to the landfills could be recycled, reused or composted. According to the Recycling Council of British Columbia, each person in Canada generates approximately 2.7 kilograms of garbage each day, which adds up to 985.5 kilograms per year. This is the weight of a large bull moose!

Of particular concern is organic waste that decomposes in an anaerobic situation like a landfill producing a gas which is composed primarily of methane. Methane is one of the greenhouse gases contributing to climate change, and it is 21 times more potent than carbon dioxide in terms of its global warming potential (U.S. Environmental Protection Agency). For every kilogram of solid waste that goes into a landfill, two kilograms of greenhouse gases are produced.

Canadian landfills account for 20 per cent of national methane emissions (Environment Canada). The amount created every year is equivalent to 27,000 tonnes of carbon dioxide every year (Environment Canada). Landfill gas can be recovered and utilized to generate electricity, fuel industries and heat buildings. Recovering and utilizing landfill gas has two major benefits. The first is that capturing and combusting landfill gas prevents substances like methane from escaping to the atmosphere and contributing to climate change. The second is that using the energy from landfill gas can replace the use of non-renewable sources of energy such as coal, oil or natural gas. Approximately 7 Mt eCO_2 are captured and combusted representing the equivalent of removing about 5.5 million cars from the road (Environment Canada).

While we can capture and burn approximately a quarter of the methane generated by organic materials already in landfills, the best way to get rid of methane is not to produce it in the first place. This means that we need to take steps to divert or keep out organic materials such as food and yard waste from landfills. These organic materials can be anaerobically digested to generate renewable energy, or composted to make compost fertilizer and soil conditioner. Diverting the organic waste from our landfills will help conserve space.

The sheer volume of waste means that many existing landfill sites are approaching capacity, and few people want new sites built near their communities. What can we do? What is the green thing to do? Rethink, refuse, reduce, reuse, recycle!

Discussion Point: If your garbage isn't picked up and trucked to a landfill, how do you dispose of it? What do you think the environmental impacts would be?

The 'R's of Being Green

What does the phrase "The Three 'R's" mean to you? Your parents might know that as "reading, 'riting, and 'rithmetic"; others might know it as "Reduce, Reuse, Recycle". Since this catchy phrase was first taught to school children a few decades ago, it has become the slogan for the environmental movement. Think of it as the 'R's of being green.

"Reduce, reuse, recycle" has been expanded to "rethink, refuse, reduce, reuse, repair, recycle". These words are interconnected in terms of reducing waste, but they are all different. They are also hierarchical or in order of importance. This means we should start at rethink, not at recycle. Many people consider their purchases based on perceived recyclability instead of need or reusability. What is recyclable in one community isn't in another, and many municipalities are finding that recycling is costing too much. What you put in your blue box may still end up in the dump after a brief detour.

Throughout this module and project, keep in mind that waste is not just created when consumers throw items away, but throughout the life cycle of a product. Waste is created and energy consumed at every step, from design to extraction of raw materials to transportation to processing and manufacturing to transportation to the store and then home.

Discussion Point: What other 'R's can you think of that you could use to help cut down on waste, or help the environment?

Rethink

The best way of cutting down on garbage is to think about our current lifestyles – what we need, what we want and how we design and make things. The more material goods we own, the more time, energy and money we commit to maintaining, replacing and housing them. Over the last 60 years, the average house size in Canada has increased from 800 square feet to 2,000 square feet, despite our families being smaller! Some argue that this materialism has trapped us in a cycle of working longer and harder to buy and maintain possessions while we are poorer in time and have little opportunity to enjoy them.

In our society, we are swamped by commercials to buy – buy the latest, buy this colour that colour, buy this style. We buy, buy, buy, whether we need it or not. A good question to ask ourselves is "do I really need this _____?". Not only is this good for the environment and the green thing to do, but it's healthy for our wallets and may improve our lifestyle too.

"Do I really need _____?" is an important question when it comes to replacing or updating our computers, cell phones and other electronics. Natural Resources Canada estimates that Canadians throw away more than 272,000 tonnes of electronics each year! Not only is that a staggering amount but these items are filled with heavy metals such as lead and mercury and other toxic chemicals that could seep into the ground in landfills. Recycling them is dangerous too as many of these elements are poisonous and can affect the health of workers and the environment.

We can also rethink the things we buy – how was it produced? What were the impacts? What kind of impact will I have when I dispose of this item once I'm done with it?

Refuse

This 'R' is refusing to buy it initially. Refuse to buy what we don't need. Refuse products that might be environmentally or socially unsustainable. Refuse items that are over packaged. Even when we are purchasing things that we do need, we get a lot of extras that harm our environment. Think of the things you buy grocery shopping – you need the pasta, not the plastic wrapper; you need the salt, not the box. The more we buy the more we have to discard or find something to do with.

Discussion Point: What are some experiences that you have had with over packaging?

Often by refusing, we can send a message to the company that we don't like that item. Better yet, we can let the manufacturer know what it is about their product that we don't like. We can change our buying habits – we could buy in bulk and avoid the packaging altogether. However, like with many things, we need to be wary and ask questions. For example, are the bulk bins being filled from small bags? If so, buying in bulk accomplishes nothing in terms of reducing packaging waste.

Yet another way we can refuse is to only buy high-quality durable items and refuse to buy cheaply-made things which often become garbage quickly. In consideration of our limited money, we look for bargains and we may buy the inexpensive inferior piece rather than more expensive quality product. Sadly, we often end up having to replace the cheaper item and the original article ends up as waste. With the cheaply-made items and toys that are available now in bargain stores, waste is mounting. When making a purchase, look for durable products that will last a long time, rather than something that might need to be replaced quickly.

Something else we can refuse is the plastic bag. Plastic bags have been a tremendous convenience but also plague – they contribute to litter issues and can take a long time to break down. For a shocking story about plastic, see the Great Northern Gyre story in Unit 4 under Oceans. Many stores are now giving us the opportunity to refuse plastic, or having us pay for the bag as an incentive not to use them. Not only is this environmental leadership, but it is also to their financial advantage to not to have to pay for bags. It's win/win for them. By bringing and using our own shopping bags, we help not only divert waste from landfills but also reduce the resources and energy that is used to produce that bag.

Check out some of these videos:

Plastic Planet: The curse of the carrier bag (11:49) – A British video looking at the ubiquitous plastic bag. Be sure to watch right to the end. http://www.myspace.com/video/petica/plastic-planet-the-curse-of-the-carrier-bag/3320169

The Majestic Plastic Bag – A Mockumentary: A satirical look at plastic bags. http://www.youtube.com/watch?v=GLgh9h2ePYw

Reduce

Reduce means to make smaller in size, amount or number. By applying the 'R' of reduce, we can minimize the amount of material and energy used during the whole of a product's life cycle.

We can reduce by cutting back on unnecessary purchases. We can also reduce our driving by combining trips, carpooling, walking, biking or taking public transportation when possible. We can take shorter showers, water the lawn less and reduce the amount of power we use by replacing less efficient appliances with Energy Star appliances. Since 1978, the weight of the two-litre pop bottle has been reduced by almost 30 per cent, from 68 grams to 48 grams (U.S. Environmental Protection Agency). So not only has the packaging industry been reducing, it has also been rethinking.

The most effective way to reduce waste is to not create it in the first place. Through waste prevention, or **source reduction**, we can save natural resources and reduce waste management costs. The way items are designed, how they are manufactured, what materials are used, how much is used can all reduce the amount of raw materials used, the transportation required and the toxicity of garbage created.

Discussion point: What do you, and your family, do to reduce?

Reuse

Reuse is a broad term that combines reusing materials and using items that have reusable qualities. It can mean investing in products that can be reused – a thermal coffee mug, a reusable water bottle and reusable shopping bag. It can mean donating or selling articles that you no longer use or need but someone might, like if you are upgrading your MP3 player or cell phone. It can mean taking an existing product that has become waste and use the material and parts without processing for another purpose. This is another 'R' word – **repurpose**. It is a great way of using items that have served their purpose and have been discarded, especially those that cannot be recycled and will end up sitting in a landfill for centuries. For example, an old shirt may become a car rag, an old tire can become a potato planter, or clean used jars can store leftovers or odds and ends.

Reusing keeps old resources from entering the waste stream, and new resources from being used. It also lowers the amount of energy needed to manufacture new products which results in less pollution!

At one time, reusing was considered unglamorous and only done if we couldn't afford anything else. Now it is trendy and exciting. The saying 'one man's trash is another man's treasure' really applies here. Buying or trading vintage, refurbished and used items is a fun and cost-effective way to get cool stuff while preventing pollution and saving the earth's precious resources.

Repair

Consider "repairing" or "restoring" (another 'R' word) an item when it breaks down or doesn't function properly, rather than throwing it out. Many products are thrown away when all they need is a bit of attention or a bit of paint. We wouldn't throw our bikes away because the tire is flat, so why throw away a jacket with a broken zipper or a chair with scuffed legs? If you don't have the skills to repair or restore something, maybe a family member or friend does.

Unfortunately, many things are now made cheaply and fixing them may cost more than to replace it, even if we do the work ourselves. Some items are designed to break down in that they are designed to have a short life; others are no longer in style; still others are replaced by more advanced technology. This is known as built-in or planned obsolescence. The idea of this is to generate sales by

reducing time between repeat purchases. Appliances are designed to last eight years, computers for two years, and cell phone for 18 months. We, as a society, need to rethink that one.

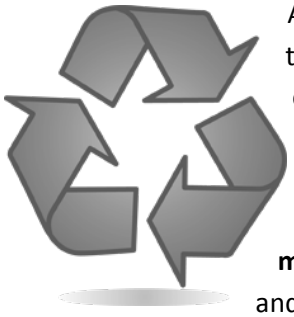
Discussion Point: What experiences have you and your family had with planned obsolescence in terms of products breaking down, items going out of style and advances in technology?

Recycle

The term **recycle** refers to the process in which an item or its components are used to create something new. Plastic bottles are recycled and made into benches and newspaper is recycled into egg cartons. Recycling is technically a form of reusing, but it refers more specifically to the reprocessing of items that might be considered waste into raw materials for use in making a new product. Recycling keeps usable materials out of the landfill reducing the need for landfills and incineration. Recycling also saves energy, decreases emissions of greenhouse gases that contribute to global climate change, and conserves natural resources such as timber, water and minerals.

There are two types of recycling, which are up-cycling and down-cycling. **Up-cycling** converts waste materials or useless products into new materials or products of better quality or a high environmental value. **Down-cycling**, on the other hand, converts materials and products into new materials of lesser quality. Both reduces consumption of new raw materials when creating new products and reducing the use of new raw materials, thus reducing energy use, air pollution and even greenhouse gas emissions.

Discussion Point: What some examples of up-cycling? Down-cycling?



Although we tend to think of recycling as dropping off our papers and cans to be picked up, recycling is actually a three step process or loop. First is the **collection and processing** step. This is done through curbside pickup, drop-off centres, buy-back centres, and deposit/refund programs. Recyclables are then sent to a materials recovery facility to be sorted and processed into raw materials, such as pulp for paper. The second step is **manufacturing**, or turning recycled raw materials into new products. More and more items are being manufactured with total or partial recycled content. Some common household items that contain recycled materials include newspapers, paper towels, soft drink containers, cans and plastic laundry detergent bottles. The third step is **purchasing recycled products.** It's up to us the consumer to complete the recycling loop. By "buying recycled,"

businesses, governments and individual consumers create a demand for more environmentally sound products and manufacturers will continue to meet that demand by producing high-quality recycled products. That's going green!

If it's this easy, why don't we just forget all the other 'R's and just recycle? Well, recycling has its downsides. Sometimes the collection side is costly, particularly if your community operates a curbside recycling system. The recyclable materials are a commodity and sometimes the demand for the material is low which means it is stockpiled (which can cost money in terms of renting a facility) or it may just go to landfill as waste. Recycling is a manufacturing process, and like any manufacturing process, it consumes energy resources, thus production of recycled goods leaves its own ecological footprints. Most materials break down over time, so they can only be recycled so often. In addition, recycling of items like electronics requires that someone must dissemble and remove metals and parts to be recycled. This e-waste may contain contaminants such as lead, cadmium, beryllium or brominated flame retardants which may put the health of workers and communities at significant risk.

Recycling is the 'R' of last resort. We should recycle as much as possible and buy products with recycled content, but we should start with the other 'R's. Rethink first, then refuse, then reduce, then reuse, then repair and finally recycle.

Discussion Point: What do you and your family recycle? Could you use one of the other 'R's instead?

Case Study – Aluminum

Aluminium cans are the most recyclable piece of "garbage" we produce. Unfortunately, it can't just be refilled; it needs to be recycled. But recycling an aluminum pop can saves 96 per cent of the energy used to make a can from ore, and produces 95 per cent less air pollution and 97 per cent less water pollution.

If an aluminium can goes to the landfill, it may take up to 500 years to break down. If we recycled an aluminium can, it would take only 60 days for that can be collected, transported, melted down, formed into a new can and placed back on shelves. Because we have a deposit on aluminium cans, not many end up in the garbage… but some still do.

Case Study – Glass

Glass is another great recycled piece of garbage. Instead of one million years in a landfill, glass can be recycled in as little as 30 days. Recycling just one glass bottle saves enough energy to light a 100 watt light bulb for four hours, or power a television for 20 minutes. Better yet, a bottle can be refilled, which is preferable to recycling it.

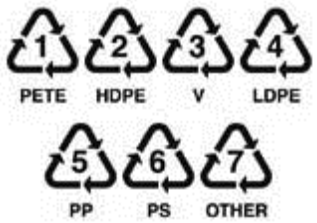
Glass is 100 per cent recyclable. That is, it can be recycled endlessly without any loss in purity or quality. Glass manufacturers require high-quality recycled glass to meet market demands for new glass containers, and the more that is used, the greater the reduction in energy use. This lowers manufacturing costs and benefits the environment by conserving raw materials, requiring less energy and reducing CO_2 emissions. For every six tons of recycled container glass used in the manufacturing process, one ton of carbon dioxide creation is avoided.

In 2009, about 39 per cent of beer and soft drink bottles were recovered for recycling, according to the U.S. EPA. Also recovered were about 18 per cent of wine and liquor bottles as well as almost 18 per cent of food jars. In total, 31 per cent of all glass containers were recycled. Glass container manufacturers hope to achieve 50 per cent recycled content in the manufacture of new glass bottles by 2013. This achievement would save enough energy to power 21,978 homes for one year while removing over 181 tons of waste from landfills on a monthly basis.

Case Study – Plastics

Recycling plastics is difficult because there are different kinds of plastic with different properties. One cannot simply manufacture a new product by combining the different kinds. Separating or finding uses for mixed plastics are major recycling challenges. This task is further complicated by increased use of multi-layer packaging, in which layers of different plastics are fused into one container.

If you look on the bottom of your plastic container to be recycled, you will see a recycle arrow symbol with a number in the middle. The number in the middle represents the type of resin that makes up the plastic. Although the numbers go up to 7, most recycling programs only take packaging made from #1 (PET or PETE) and #2 (HDPE) resins. Some are even more restrictive – for example, only #2 containers with necks but not wide mouths because the two are formed differently and have different melting points. The wrong kind of plastic can "contaminate" the whole batch, turning it into garbage as far as the company with the recycling contract is concerned.



Unlike glass, plastic cannot be recycled indefinitely. Plastic containers are expensive to pick up and sort because they are lightweight; even the automatic sorting equipment can be expensive. Some resins are difficult to clean, and unfortunately, virgin resins can be cheaper to buy. In addition, each piece of recycled plastic represents a potential environmental threat. The process of melting down and recycling plastic produces VOC, or volatile organic compounds, fumes that can harm plant and animal life near the industrial site. Plastic resin, which is part of the manufacturing and recycling process, can leech into foods stored in recycled plastic containers and can increase with the type of plastic used and the plastic's age. Consequently only a very small amount of recycled plastic, if any, is used for food containers and packaging.

Because of the potential health threats recycled plastic pose, much plastic recycling is actually down-cycled. This means that the plastic, instead of becoming another new container, becomes a different, less useful product. For example, a plastic water bottle may be down-cycled to become artificial turf or plastic furniture. After down-cycling, plastic is generally unfit for another round of recycling. This means that it ends up in a landfill.

Our best action could be to buy glass where available. If glass is not an option, then choose plastic made from #1 or #2.

Unit 4: Water

About 70 per cent of the earth is covered in water – 97.5 per cent is sea water and three-quarters of the remaining 2.5 per cent is locked in permanent snow cover at the polar ice caps and in glaciers. The tiny bit leftover is drinkable. Estimates of Canada's supply of fresh water vary from 5.6 per cent to 9 per cent to 20 per cent of the world's supply, depending on how one defines "freshwater" – whether it means "available," "usable," or merely "existing".

Freshwater has two components – surface and ground water. **Surface water** is the water we can see, our lakes, streams and rivers. **Ground water** is the water than runs beneath the surface, filling the spaces between the rocks and soil. Almost nine per cent, or 891,163 square kilometres, of Canada's total area is covered by fresh water. This is more lake area than any other country in the world and is slightly smaller than British Columbia or the size of Newfoundland and Labrador added together with the Yukon! An estimated area of 200,000 square kilometres, or about two per cent of the country's area, is covered by glaciers and ice fields. That's about the size of England and Scotland together. Not only that, but we have more water underground than on the surface.

Human Need

Water is essential to all known forms of life – humans, plants, animals. For us humans, water delivers oxygen and nutrients to different parts of the body, and removes toxins and waste from the body. Water also regulates our body temperature through perspiration and reduces friction between joints to facilitate movement. We can survive without food for about 30 to 40 days, but we can only survive a few days without water.

Experts disagree on how much water we need a day, but most recommend about two to 2.5 litres a day. We get this water from the foods we eat from drinking. Although the human body is between 65 per cent and 90 per cent water depending on body size, a mere two per cent drop in body water can trigger fuzzy short-term memory, trouble with basic math, and difficulty focusing on the computer screen and a 12 per cent loss can result in death.

Water is a fundamental resource for our global food production – water is needed for agriculture, livestock production, fisheries and aquaculture. Water is also crucial for industrial activity and municipal services.

Natural World Need

So not only do we need water, but so does our natural world. Often we speak of water as a resource or something to use, but both fresh and salt water are important ecosystems. Rivers, lakes, swamps and oceans provide food and habitat for a wide variety of creatures both plants and animals. The viability of these areas depends on both the quality and quantity of water. For example, a lake needs to be replenished; if too much water is drawn from it, it may warm up and as a result of the warming; the creatures that make this area home may die out. Or, too much pollution may result in more algae growing there creating an algae bloom which will use up the available oxygen resulting in a large fish die-off.

Wetlands are areas that are permanently and seasonally covered with water. They are diverse ecosystems – they provide food, shelter and nesting sites for all kinds of animals – and one of the most productive and dynamic environmental habitats on earth. However, fifty per cent of the world's wetlands have been lost since 1900. Canada has approximately 25 per cent of the world's wetlands which is the largest wetland area in the world (Environment Canada). Wetlands, including lakes, have a total area of more than 1.2 million square kilometres and cover about 14 per cent of the land area of Canada (Natural Resources Canada). That's the size of Quebec, Canada's largest province. Fifteen to 25 per cent of the Prairie Region is wetland. The Great Lakes are the largest system of fresh, surface water on earth, containing roughly 18 per cent of the world's fresh surface water. Since European settlement, it is estimated that Canada has lost about 20 million hectares or 200,000 square kilometres of wetlands to agricultural developments alone.

In this unit, we will look both at water quantity and quality as well as our oceans and their health. We use water to cook our food, bathe, wash our clothes, water our lawns and carry away the various by-products of our day-to-day lives. We use it to generate power, manufacture goods, grow crops and dispose of wastes. We return it to the environment, often to the same body of water it came from and usually in a much poorer state.

While demand for water is on the rise, pollution, declining water tables, and prolonged drought conditions are shrinking the usable supply. We use water every day at home and at work in so many situations that we take it pretty much for granted. To be green, we need to understand some of the issues and take steps to address them.

Freshwater Use

Quantity – Conservation: The global demand for water is enormous – and growing. About 3,800 cubic kilometres or 145 bathtubs of freshwater for every Canadian are withdrawn annually from the world's lakes, rivers and aquifers, twice the volume extracted 50 years ago. As outlined above, Canada has some of the world's most extensive water resources. But we also consume far more per person than in other countries. According to the World Resources Institute (2005), Canada's water consumption was 1,494

cubic metres per capita in 2000 – that's almost 75,000 bathtubs. In our homes, Canadians consume 350 litres of water a day per capita or almost two bathtubs of water a day, which is second only to the Americans as the biggest users, and arguably wasters, of water in the world. The average global citizen needs only between 20 and 40 litres of water a day for drinking and sanitation.

Just the Facts Ma'am

- 70% of the water we use in our homes in used in the bathroom, and toilets are the single biggest user.
- 35% bathing and showering – five minute shower uses 100 litres, five minute shower with a low-flow shower head uses less than 50 litres of water, a tub bath uses 60 litres.
- 30% toilet – one flush uses 15-19 litres.
- 20% laundry – washing machine uses 225 litres.
- 10% kitchen and drinking – dishwasher uses 40 litres, dishwashing by hand uses 35 litres.
- 5% cleaning – hand washing with tap running uses 8 litres, brushing teeth with tap running uses 10 litres.
- A single lawn sprinkler spraying 19 litres per minute uses more water in just one hour than a combination of ten toilet flushes, two – five minute showers, two dishwasher loads, and a full load of clothes.

Industry is Canada's largest water user, using 68 per cent of the total water used in Canada in 2000 (WRI, 2005). Domestic water use – which includes water used in commercial establishments and public services such as schools and hospitals – accounted for 20 per cent of total water use in Canada in 2000 (WRI, 2005). The good news is that our average residential water use per person has been slowly dropping over the last 10 years – from 335 litres per day in 2001 to 329 litres per day in 2004 to 274 litres per day in 2009. (Environment Canada 2007, 2011). So, we are doing better.

Although Canada as a whole is blessed with water, not all parts of Canada at all times of the year have access to lots of water. Thus, even Canada has water quantity issues at some time of the year.

Just the Facts Ma'am

- Approximately 300 litres of water is required to produce one kilogram of paper.
- It takes about 215,000 litres of water to produce one metric ton of steel.
- Approximately 1,000 kilograms of water is required to grow one kilogram of potatoes.

Discussion Point: What are ways that we can reduce the amount of water we use?

Check out some ideas on the Internet. Try the Environment Canada website: https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=F25C70EC-1#granted

Water Quality – Pollution

Not only should we be concerned about the quantity of water we use, but also the quality. Not only are our health and well-being dependent on clean water but so are ecosystems. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.

Over one billion people on earth do not have access to clean drinking water, however in Canada; we often take clean water for granted. Our drinking water is closely monitored and treated to ensure that it is fit for human consumption. But not all our water; many of our lakes, rivers and ponds are becoming unsafe for our everyday use and unable to support aquatic life.

Freshwater bodies have a great ability to break down some waste materials, just not in the quantities discarded by today's society. Consequently, water is becoming polluted and contaminated through municipal, agricultural and industrial wastes, including many toxic synthetic chemicals which cannot be broken down at all by natural processes. Even in tiny amounts, some of these substances can cause serious harm.

Just the facts Ma'am

Did you know that one drop of oil can make up to 25 litres of water unfit for drinking?

In Canada, wastewater or sewage from our homes, schools and businesses is collected by a sewer system. In rural areas, the waste is collected in septic tanks or cess pits and is treated or collected in vehicles and taken for treatment or disposal. In more urban areas, sewage is collected and transported by a network of pipes and pump stations to a municipal treatment plant. Surface runoff or storm water, however, is not usually part of a sewage and treatment system. Everything that goes into a storm drain eventually ends up in fish and wildlife habitat. As this water is not treated and filtered for pollutants and drains flow directly into water bodies, anything other than rainwater is a potential contaminant. Putting toxic chemicals, paints, pesticides, cleaners, or even soaps, into storm sewers causes shifts in the chemistry of the water that can negatively impact aquatic life downstream. When washing the car or dog, do it on the lawn and let the water flow

through the earth before it reaches a water body than to flow on the surface until it finds a drain. Soil and plants help to filter and dilute any toxins. If you are not certain that a given substance is non-toxic, dispose of it in your community's hazardous waste facilities.

In Canada, the main impacts of water pollution are eutrophication, acidification and toxic contamination.

Eutrophication is the artificial enrichment of an aquatic system through the addition of nutrients, especially phosphates and nitrates. Phosphorus and nitrogen are important nutrients in fresh water. At high levels, these promote excessive growth of algae, and when the algae die and decompose, water is depleted of available oxygen, causing the death of other organisms, such as fish. It may occur naturally but can also be the result of human activity through industrial waste, fertilizer runoff and sewage discharge. Eutrophication is a serious water quality issue for the Prairie provinces, southern Ontario and Quebec.

Acidification is the decrease of pH in water. This can occur naturally but has been made worse by agricultural run off and by atmospheric pollution through high sulphur dioxide and nitrogen oxide emissions of industry and transportation. Acidification, or acid rain, results in changes to the aquatic ecosystem as many plants and animals cannot tolerate a more acidic system. At the same time, toxic metals may be released. Provinces that are part of the Canadian Shield, like Ontario, Quebec, New Brunswick and Nova Scotia, are hardest hit because their water and soil systems cannot fight the damaging consequences of acid rain.

Toxic contamination of the environment and the potential risk to human health is the result of the increased production and widespread use of synthetic organic chemicals and metals since the 1940s. These compounds can be acutely toxic as long-term, low-level exposure can increase the risk of cancer, birth defects and genetic mutations. While the concentrations of toxic chemicals such as PCBs may be so low that they are almost undetectable, they become concentrated, or **biomagnify**, through the food chain. Predator fish such as large trout and salmon can have levels that are a million times higher. These toxic substances continue to biomagnify in birds and other animals that eat fish, including humans. In fact, a person who eats one meal of lake trout from Lake Michigan will be exposed to more PCBs then than in a lifetime of drinking water from the lake.

Overall, Canada's water quality is better today than it was 30 years ago. New waste-water treatment facilities have helped. Although phosphorous discharge decreased in the 1980s and 1990s, phosphorus levels have been on the rise for the last decade. Phosphorus decreased by 44 per cent, with 4,950 tonnes of total phosphorus released to surface waters from municipal waste-water treatment plants in 1999 (Conference Board of Canada). In 2006, phosphorus releases increased to 6,874 tonnes (Environment Canada).

Nitrogen rose over the 1980s and 90s. In 1999, 82,750 tonnes of total nitrogen (i.e., nitrogen in all its chemical forms) were released to surface waters in Canada through municipal waste-water

discharges (Conference Board of Canada). This was a 24 per cent rise over 1983 levels. However, nitrogen releases have decreased since 1999 – down to 52,702 tonnes in 2006. Nonetheless, elevated concentrations of both phosphorus and nitrogen remain a critical water quality issue in Canada.

Oceans

The oceans are unique to our planet; no other planet in our solar system has liquid water. As mentioned previously, the oceans cover about 70 per cent of the earth's surface, and they contain about 97 per cent of the earth's water supply. The oceans are home to an incredible number of plants and animals, and are a main source of protein for about one billion people (World Resources Institute). However, because the oceans are so deep and dark, they are hard to study and we know very little about them.

Harvesting

People used to think that since the oceans were so big it would be impossible to catch all the fish that lived in them. Unfortunately, we are learning that the ocean has limits to what it can handle. Worldwide, almost 80 per cent[5] of the world's fisheries are in trouble. Over 25 per cent of all the world's fish stocks are either **overfished** (that is, more fish are being taken than are being born) or **depleted** (or the fish population is so low that it can't function or reproduce properly). Another 52 per cent of the fishery is **fully exploited**, which means that the number of fish taken out equals the number being born. Any further increase in fish caught will lead to overfishing, and then to collapse.

An example of this in our country is the Northern cod fishery in the Atlantic. For the past 500 years, the cod fishery had largely shaped the lives and communities of Canada's eastern coast. The stocks have been overfished since the late 1950s; they partially collapsed in the 1970s and then abruptly collapsed in 1992. As a result, the Canadian government declared a moratorium on this fishery and it sadly remains in place 30 years later.

What can we do? Do we give up eating fish to be green? No, but we can make good choices about what fish are being sustainably harvested and have healthy populations. One tool available to help is SeaChoice, which has developed easy-to-use tools based on scientific assessments that help us make the best seafood choices. It was launched in 2006 to help Canadian businesses and shoppers take an active role in supporting sustainable fisheries and aquaculture at all levels of the seafood supply chain. You can check it out at http://www.seachoice.org/wp-content/uploads/2012/04/SC_card_2012_5panel_web.pdf

[5]State of World Fisheries and Aquaculture (SOFIA) – http://www.fao.org/sof/sofia/index_en.htm.

Pollution

Another issue facing our oceans is pollution, and is taking a toll on the marine life at an alarming rate. It is the contamination of ocean water by harmful chemicals which are discharged as a result of human or natural activities. It has led to the destruction of habitat of several marine animals and plants which are now threatened with extinction.

Sewage waste discharge into the oceans is one of the major sources of pollution. Sewage is either discharged into the oceans directly, or dumped into the rivers and is carried to the oceans. Sewage waste discharge into the oceans is not just restricted to land-based structures as large vessels also dump tons of garbage into the oceans every single day. In fact, a single cruise ship is known to generate, and dump, more than a million gallons of waste water into the ocean on a single trip.

Another prominent cause of ocean pollution is industrial waste which is much more harmful than sewage water. This is because the pollutants are toxic metals such as cadmium, mercury, lead, polychlorinated biphenyl (PCB) and polycyclic aromatic hydrocarbon (PAH). These toxic metals which are suspended in the waste water are also introduced into the oceans either directly or through the rivers.

Agricultural waste is another concerning source, particularly in countries which still rely on agriculture. The chemicals used in agricultural practices most often make it to the oceans in form of surface run-off following heavy rains. At times these chemicals can also seep into the ground, get mixed into ground water, and make it to the oceans eventually. Fertilizer runoff is a huge problem. The extra nutrients create eutrophication, a flourishing of algae blooms which depletes the oxygen content in the water, suffocating marine life.

Oil spills are an issue we have heard a lot about recently. Given what happened in the Gulf of Mexico in 2010, we know that oil spills are not just from ships that carry oil. This oil spill was from offshore oil drilling, but oil can enter the ocean through surface run-off, marine transportation, routine maintenance of ships and natural oil seeps. In fact, only 12 per cent comes from tanker oil spills.

Air pollution can also fuel ocean pollution, in that the oceans absorb carbon dioxide from the atmosphere. Given the rise in atmospheric concentration of carbon dioxide as a result of various human activities, this type of contamination is increasing.

One of the most serious threats to our oceans is plastics. Plastic constitutes approximately 90 per cent of all trash floating on the ocean's surface, with 46,000 pieces of plastic per square mile (United Nations Environment Program). The pieces can be almost any size – from a tiny pellet the size of a seed to something as big as a sofa. Why is there so much plastic in the ocean? Unlike other types of trash, plastic does not biodegrade; instead, it photo-degrades with sunlight, breaking down into smaller and smaller pieces, but they never really disappear. These plastic pieces are eaten by marine life, wash up on beaches, or break down into microscopic plastic dust, attracting more debris.

Plastic is also unusually toxic once it enters the ocean environment. Plastic particles are magnets for different types of pollutants, such as DDT (dichlorodiphenyltrichloroethane) and POPs (Persistent Organic Pollutants), and release harmful chemicals such as BPA (Bisphenol A). These can **bioaccumulate**. That means organisms at the bottom of the food chain, such as plankton and krill, ingest the chemicals along with the microscopic plastic particles and as larger fish consume the smaller ones, the chemicals work their way up the food chain. Ultimately, people consume the largest fish, having a devastating effect on human health.

Plastic is also swept away by ocean currents, landing in swirling vortexes called **ocean gyres**. There are five gyres in the world's oceans – North Pacific, North Atlantic, South Pacific, South Atlantic and Indian Ocean. All are affected by plastic. The North Pacific Gyre off the coast of California has been studied the most and is home to the Great Pacific Garbage Patch, the largest ocean garbage site in the world. Here, two whirling areas of plastic garbage have been found, the Western Garbage Patch between Hawaii and Japan, and the Eastern Garbage Patch between Hawaii and California. The eastern patch is estimated to be twice the size of Texas, with plastic pieces outnumbering sea life by a measure of six to one. These floating garbage sites are impossible to fully clean up. No one knows how much garbage is in the gyre, but it's probably millions of pounds.

Read on How Stuff Works about this issue:

- http://science.howstuffworks.com/environmental/earth/oceanography/great-pacific-garbage-patch.htm

Check out some film clips on the Internet on the Great Pacific Garbage Patch:

- **Modern Marvels – Pacific Gyre** (3:25) http://www.youtube.com/watch?v=cPUS-R0bFos
- **Charles Moore – the Great Pacific Plastic Trash Island** (7:21) http://www.youtube.com/watch?v=en4XzfR0FE8&feature=related
- Planet **100 – The Pacific Trash Vortex** (2:42) http://www.youtube.com/watch?feature=fvwp&NR=1&v=xc6LvdsyJ4U

Despite these alarming facts, there are actions we can take to address the problem of plastics.

- **Use Less Plastic** (1:49) http://www.youtube.com/watch?v=LZ71svh1RVo
- **Plastic Bags are Evil** (1:46) http://www.youtube.com/watch?v=i20tw5Gcjfg&feature=related
- **The Dangers of Plastic Bags** – longer (8:55) http://www.youtube.com/watch?v=lhxX1g9A2OM&feature=related

Just the facts Ma'am…

- 8% of the world's oil is used for plastic production.
- Marine debris, especially plastic, kills more than 1,000,000 seabirds and 100,000 mammals and sea turtles every year.
- Studies done in the North Sea revealed that fulmars, a type of seagull, averaged thirty pieces of plastic in their stomachs.
- Researchers found that in the middle of the North Pacific, there are six pounds of plastic for every one pound of algae.
- 267 species around the world are harmed by plastic – 44% of seabirds, 43% of ocean mammals and 86% of sea turtles ingest or become tangled in plastic. That is over 100,000 marine mammals and one million seabirds.
- Almost every marine organism, from the tiniest phytoplankton to whales is contaminated with man-made chemicals.

Unit 5: Air Quality

Like water, we need air to live. Each day we take about 26,000 breaths and inhale around 14,000 litres (14 cubic metres) of air – or 700 full bathtubs. If this air contains pollutants, we inhale them into our bodies and they can affect our health. Some effects are brief – like coughing on an extremely smoggy day; others can last our whole lives – like asthma or other respiratory problems. The pollutants can also affect the health of our surrounding environment. So to protect people's health, and the environment, we need to keep the air clean and free from pollution.

What are pollutants?

They are chemicals and particles in the environment that have the potential to affect our health and the environment. They are also known as **contaminants**.

Many of our daily activities release chemicals and particles into the air we breathe. You may have noticed how the air smells differently in the country, or in a town that has a pulp mill, or even in the city. Many of those smells are related to pollutants. For example, pulp mills release carbon dioxide, sulphur dioxide and hydrogen sulfide out their stacks and motor vehicles release carbon monoxide, nitrogen oxide and hydrocarbons from their exhausts. If we use a wood stove to heat our homes, particles and other chemicals are released out of the chimney. When they build up in the air, they cause air pollution. The amount of pollution in the air depends on the amount produced and the rate at which the contaminants disperse, or move away.

Different types of air contaminants can affect our health and the environment in different ways. Sometimes we can't even see and smell air pollution. One of the challenges is that the sky has no boundaries. Wind can carry air contaminants thousands of kilometres from its original point, from one province to another or from one country to another. Think back to some summers when the skies are hazy from forest fires far away. Because we all share the air we breathe, air pollution is a global issue.

Parts of Canada have issues with air quality. Smog is an air quality issue in many parts of Canada, particularly urban areas. It often appears as a haze in the air, and is a mixture of gaseous pollutants such as ground-level ozone and small solid and liquid particles called particulate matter. Acid rain is another.

Acid rain is the result when two common pollutants from car exhaust and factories, nitrogen oxide and sulphur dioxide, combine with water in the air to form a weak acid, which then returns to the earth as rain. As mentioned in Unit 4 on water, acidification is a serious issue in the provinces that

are part of the Canadian Shield (Ontario, Quebec, New Brunswick and Nova Scotia). Here, the water and soil lack natural alkalinity to neutralize acid naturally and cannot fight the damaging consequences of acid rain. These areas also have much of the country's population and industry and therefore, the greatest concentration of nitrogen and sulphur oxide release. In fact, more than half of Canada consists of susceptible hard rock (i.e., granite) areas that do not have the capacity to "buffer" against acid rain naturally. Areas of northeastern Alberta, northern Saskatchewan and Manitoba, parts of western British Columbia, Nunavut and the Northwest Territories could be susceptible but have been "saved" by lack of industrialization and its resulting pollutants. However, development like Alberta's Tar Sands might create an acid rain situation in Western Canada as well.

The term "acid rain" sounds like something out of a science fiction movie, but why is it so terrible? It changes what can live in our lakes, streams and river by increasing the amount of acid. This makes it harder for existing aquatic plants and animals to get oxygen. The plankton, clams, crayfish, fish and aquatic plants die out to be replaced by acid-loving bottom plants and black flies. Fish-eating birds also disappear. In the forests, acid rain damages the surfaces of leaves and needles, reducing a tree's ability to withstand cold. It binds the nutrients in the soil that the trees need, so they grow more slowly or stop growing altogether. Trees exposed to acid rain may also have more difficulty withstanding other stresses, such as drought, disease, insect pests and cold weather. The area around Sudbury, Ontario is an often-cited example of the moonscape that results from prolonged acid rain exposure.

If it kills fish and trees, what does acid rain do to people and our environment? Recent studies have identified strong links between high levels of airborne sulphate particles and increased hospital admissions for heart and respiratory problems, increased asthma-symptom days, as well as higher death rates from these ailments. Some acid rain is even strong enough to damage buildings, peel paint and break down rock!

To judge the health of our air, Environment Canada looks at five air quality indicators – particulate matter (PM), ground-level ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and volatile organic compounds (VOC). The levels of these contaminants in outdoor air are influenced by many factors such as local emissions sources, weather conditions and the transport of air pollutants over long distances.

Below is a table that outlines some of the major air pollutants, where it comes from, its potential effects on human health and the environment, and Canada's situation.

Pollutant	Causes	Issues	Situation*
Particulate matter (PM) Small airborne particles. Contributes to haze and reduces visibility.	**Manmade sources:** • Industrial extraction and processing • Road and construction dust • Exhaust from cars and trucks • Burning wastes • Cigarette smoke **Natural sources:** • Wildfires • Windblown dust • Sea salt spray	**Area affected:** Any region of Canada year-round, rural or urban. **Health issues:** • Irritation of eyes, throat and lungs • Various forms of heart disease • Susceptible groups: children, adults with existing respiratory conditions, such as asthma, bronchitis or emphysema, and the elderly **Other damage:** • Soiling and discoloration can lead to physical and chemical degradation of metals, wood, stone, painted surfaces and fabrics • Accumulate on plant surfaces and leach into soil, increasing a plant's susceptibility to disease	Since 1990, Canada has lowered PM pollution. Recently has remained roughly the same with yearly and regional fluctuations (due to forest fires, pollution from the U.S., and warm, dry weather). **Comparison to other developed countries:** Norway and the UK have made more progress than Canada.
Ground-level ozone (O_3) Reactive gas that can absorb ultraviolet (UV) radiation. Major component of smog along with particulate matter.	Not directly emitted but formed in the atmosphere when other gases (nitrogen oxides and volatile organic compounds) react in sunlight.	**Area affected:** Wind currents can move ozone and affect regions far from original sources. **Health issues:** • Irritation to eyes, nose, throat and lungs leading to coughing and headaches • Reduce lung function • Aggravation of asthma and other lung diseases • Susceptible groups: people with asthma and lung disease, healthy adults exercising for long periods of time outdoors, and older people, particularly those with heart disease **Other damage:** • Toxic to plants in high concentrations; affects photosynthesis and plant respiration, slows growth and affects reproduction • Corrosive to most materials at high concentrations, including plastics and metals • Scatter light and can affect visibility	Rising over the last 20 years. Some due to warmer and drier environment and to transboundary pollution from the United States.

Nitrogen dioxide Nitrogen dioxide (NO_2) forms when nitrogen oxide (NO) and other nitrogen oxides (NO_x) react with other chemicals in the air to form nitrogen dioxide. Component of smog and acid rain.	Released during the combustion of fossil fuels, mainly by vehicles, electricity generation and manufacturing processes.	**Area affected:** Highest in urban areas. Can originate in one place and be transported long distances by prevailing winds, contributing to poor air quality and acid rain in other urban and rural areas. **Health issues:** • Irritate and decrease function of lungs • Lower resistance to respiratory infection • Susceptible groups: young children, asthmatics of all ages (but especially children), and adults with heart and respiratory disorders such as bronchitis. **Other damage:** • Lake acidification and harm to aquatic ecosystems • Damage trees and crops substantial environmental losses • Can be corrosive to building materials at high concentrations • Reduce visibility through haze	Modest per capita decrease of 15% from 1990 to 2005. Canada and the United States have agreements to reduce emissions of nitrogen oxides (NO_x). **Comparison to other developed countries:** Germany lowered its per capita emissions by 61%, Switzerland by 52 % and the UK by 48%.
Sulphur dioxide (SO_2) Colourless gas with a characteristic pungent smell. Forms sulphuric acid when combined with water. Contributes to acid rain.	Emitted when a fuel containing sulphur is burned. Industrial processes such as smelters, electricity generators, iron and steel mills, petroleum refineries, pulp and paper mills and metal ore smelting.	**Area affected:** Areas of manufacturing and high urban areas – parts of Quebec and Ontario, and all of New Brunswick, Nova Scotia and PEI. **Health issues:** • Irritation of nose, throat and lungs • Cause of respiratory problems, such as bronchitis • Has been linked to heart disease • Susceptible groups: children, adults with existing respiratory conditions, such as asthma, bronchitis or emphysema **Other damage:** • Contributes to acidification of aquatic and terrestrial ecosystems • Damages vegetation, buildings, and materials • Contributes to visibility impairment and regional haze	Substantial decrease of 44% per capita between 1990 and 2005 through decrease in sulphur content in fuels. Met obligations to lower its SO_2 emissions set out in international agreement. **Comparison to other developed countries:** Canada made weak progress compared to Germany (92%), Denmark (88%) and the UK (82%).

Volatile organic compounds (VOC) Solid or liquid organic compounds containing one or more carbon atoms that evaporate readily to the atmosphere to become gases. VOCs form particulate matter (PM) and react with nitrogen oxides to form ground-level ozone that forms smog.	**Natural sources:** • Vegetation • Forest fires • Animals **Manmade sources:** • Transportation • Solvent usage • Oil and gas industry • Consumer products – household cleaners, personal care products, paints and printing inks	**Area affected:** Populated and industrialized **Health issues:** • Toxic air pollutants that can cause cancer and other serious health problems • Damage to, and decrease function of, lungs • Susceptible groups: children, people with respiratory disorders such as asthma and people who work or exercise outside	VOC concentration has decreased 57% in the last 15 years, mostly from more stringent emissions standards. **Comparison to other developed countries:** • Canada lags behind other industrial countries in reducing VOC emissions in consumer and commercial products. • Placed last among 17 developed countries. Others like Germany have lowered emissions by more than 70%.

*Based on report "How Canada Performs", from the Conference Board of Canada on Canada's socio-economic performance.

Indoor Air Quality

Just as we have outdoor air pollution from car exhaust and factories, we have indoor air pollution from household cleaners, paints, glues, cigarettes and moulds that release gases or particles into the air. When the gases and particles are not diluted by air from the outdoors or carried outside, they become a problem. High temperature and humidity levels can also increase concentrations of some contaminants.

The causes of indoor air pollution in any home are many and wide. It can happen anytime when we heat our houses, when we cool or humidify our homes, when someone smokes, when we spray for insects, when we use cleaners, when we use body sprays or even when we do our hobbies. It can even happen when our carpet gets wet or damp. Have you ever noticed the smell of new paint, new carpet or even a new bookcase? That is **off-gassing** or the release of chemicals into the air through evaporation. After a while, we can't smell it but the off-gassing can continue for years. This means that we continue to breathe these chemicals as we work, sleep and relax in our homes, schools or offices.

The relative importance of any single source depends on how much of a given pollutant it emits and how hazardous those emissions are. This includes how old the source is and whether it is properly maintained. For example, an improperly adjusted gas stove can emit significantly more carbon monoxide than one that is properly adjusted.

Some sources, such as building materials, furnishings and air fresheners, release pollutants more or less continuously. Others release contaminants intermittently. These include smoking, the use of unvented or malfunctioning stoves, furnaces or space heaters, solvents in cleaning and hobby activities, paint strippers in redecorating activities and cleaning products and pesticides in housekeeping. High pollutant concentrations can remain in the air for long periods after some of these activities.

Health effects from indoor air pollutants may be experienced soon after exposure or possibly years later. Immediate effects after just one, or repeated, exposure include irritation of the eyes, nose, and throat, headaches, dizziness and fatigue. These are usually short-term and treatable, sometimes by just eliminating the person's exposure to the source of the pollution. Symptoms of some diseases like asthma may also show up soon after exposure. The likelihood of immediate reactions to indoor air pollutants depends on age, pre-existing medical conditions and individual sensitivity – which varies tremendously from person to person. Some people can become sensitized to moulds, house dust, pollen and even pets after repeated exposures, and it appears that some people can become sensitized to chemical pollutants as well.

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include some respiratory diseases, heart

disease and cancer, can be severely debilitating or fatal. Because of the health effects and because some of these pollutants aren't noticeable, we should try to ensure the indoor air quality is good.

Take a house tour of the most common forms of indoor air quality pollutants:

- http://www.epa.gov/iaq/IAQhouse_working.html

When it comes to volatile organic compounds (VOC), houseplants are a common ordinary everyday remedy. In the late 1980s, NASA did research on houseplants as a way to purify the air in space facilities. We can use that information in our homes today. Many plants remove chemicals from off-gassing, solvents and cigarette smoke, such as benzene, toluene and xylene, which can cause cancer. Plants can also remove carbon dioxide, formaldehyde, nitrogen oxides and generally purify the air. Check the Internet for which type of plant would work for you.

The more common indoor pollutants are outlined in the table below including sources, health symptoms and solutions.

Pollutant	Sources	Health Issues	Solution*
Carbon Monoxide (CO) Colourless, odourless and tasteless gas that interferes with the delivery of oxygen throughout the body.	Unvented kerosene and gas space heaters, leaking chimneys and furnaces, gas water heaters, wood stoves, and fireplaces, gas stoves, generators and other gasoline powered equipment, automobile exhaust from attached garages, and tobacco smoke.	• Flu-like symptoms that clear up after leaving home. • Fatigue in healthy people and chest pain in people with heart disease. • At high concentrations – headaches, dizziness, weakness, nausea, confusion, and disorientation. • Fatal at very high concentrations. **Susceptible groups:** Fetuses, infants, elderly people, and people with anemia or with a history of heart or respiratory disease.	• Maintain and properly adjust fuel burning equipment. • Open flues when fireplaces are in use. • Make certain that doors on all wood stoves fit tightly. • Repair any leaks promptly. • Use additional ventilation when high levels of CO are expected for short periods. • Do not idle the car inside garage.
Radon (RN) Radioactive, colorless, odorless, tasteless and extremely toxic gas.	Occurs in soils where uranium and radium are found which are found everywhere in the world. When it enters a building constructed on top of this soil, it can build up and become a health concern. Can seep into house through cracks in solid floors, construction joints, cracks in walls, gaps in suspended floors, gaps around service pipes, cavities inside walls, and the water supply.	Lung cancer as a result of radioactive particles lodging in lungs.	• The only way to know is test your home. If the level is high, take action to lower it and the higher the level, the sooner it needs to be fixed. • Reducing radon in a home can be done by: • Increasing ventilation to allow an exchange of air. • Sealing all cracks and openings in foundation walls and floors, and around pipes and drains. • If particularly high, active soil depressurization can be undertaken by a contractor. A pipe with a fan attached is installed through the foundation floor. This draws radon from under the home and releases it outside, where it is diluted.

Volatile organic compounds (VOCs) Gases from certain solids or liquids. Include a variety of chemicals.	A wide array of products numbering in the thousands: • Paints and lacquers, paint strippers, cleaning supplies, wood preservatives, aerosol sprays, cleansers and disinfectants, moth repellents and air fresheners, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions, stored fuels and automotive products. **Formaldehyde** – glues and adhesives, paints and coatings, even in clothing and draperies (adds permanent-press qualities to items). **Methylene chloride** – paint strippers, adhesive removers, and aerosol spray paints. **Benzene** – environmental tobacco smoke, stored fuels and paint supplies, and automobile emissions in attached garages. **Perchloroethylene** – the chemical most widely used in dry cleaning.	• Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment. • Can also cause loss of coordination, nausea; damage to liver, kidney, and central nervous system. • Some are suspected or known to cause cancer.	• Use household products according to manufacturer's directions. • Make sure you provide plenty of fresh air when using these products. • Throw away unused or little-used containers safely; buy in quantities that you will use soon. • Keep out of reach of children and pets. • Never mix household care products unless directed on the label. • Identify, and if possible, remove the source. • Find other, more environmentally sound alternatives!

Particulates Very fine air-borne particles Released when fuels are incompletely burned, can lodge in the lungs and irritate or damage lung tissue.	Fireplaces, wood stoves, and kerosene heaters, second hand cigarette smoke.	• Eye, nose, and throat irritation; respiratory infections and bronchitis; lung cancer • Harmful to children's health including asthma, Sudden Infant Death Syndrome (SIDS), bronchitis and pneumonia and ear infections.	• Vent all furnaces to outdoors. • Don't use unvented space heaters in confined space. • Make certain that doors on all woodstoves fit tightly. • Have a trained professional inspect, clean, and tune-up central heating system annually. • Change filters on central heating and cooling systems and air cleaners regularly. • Don't smoke indoors – better yet, don't smoke.
Asbestos Mineral fiber that occurs in rock and soil.	Variety of building construction materials for insulation and as a fire-retardant including roofing shingles, ceiling and floor tiles, paper products, and asbestos cement products. Also used in automobile clutch, brake, and transmission parts, heat-resistant fabrics, packaging, gaskets, and coatings. Asbestos-containing materials are disturbed by cutting, sanding or other remodeling activities that can release asbestos fibers into the air in homes, increasing asbestos levels and endangering people living in those homes.	• Lung disease and cancer. • Asbestosis – serious, progressive, long-term non-cancer disease of the lungs where asbestos fibers have irritated lung tissues and caused scarring which makes it hard for oxygen to get into the blood. Shortness of breath and a dry, crackling sound in the lungs while inhaling. • Mesothelioma – rare form of cancer found in the thin lining (membrane) of the lung, chest, abdomen, and heart.	Leave asbestos-containing material in good condition alone. If unsure whether or not the material contains asbestos, hire a professional asbestos inspector to sample and test the material. If asbestos-containing material is damaged (unraveling, frayed, breaking apart), isolate the area by keeping pets and children away and do not touch or walk on it. Contact an asbestos professional immediately on how to proceed.
Mould Living organism, survives by using plant and other organic materials for food.	Found almost anywhere; can grow on virtually any organic substance (wood, paper, carpet, foods, and insulation) as long as moisture and oxygen are present.	• Headaches, breathing difficulties, skin irritation, allergic reactions, and aggravation of asthma symptoms. • Type and severity of symptoms depend on types of mould, extent of exposure, age of victims and their existing sensitivities or allergies.	• Control the moisture to control mould growth. • Install and use outdoor vented exhaust fans in kitchens and bathrooms. • Ventilate the attic and crawl spaces to prevent moisture build-up. • Clean and refill humidifiers with fresh water daily. • Thoroughly clean and dry water-damaged carpets and building materials within 24 hours if possible or consider removal and replacement. • The key to mold control is moisture control.

Light Pollution of the Night Sky

Another type of pollution is **light pollution**, which is any nighttime artificial light that shines where it's not needed. This artificial light competes with starlight in the night sky making it difficult to see features, and like any other form of pollution, it wastes energy, disrupts ecosystems and has adverse health effects. It is a side-effect of industrial civilization and its sources include building exterior and interior lighting, advertising, commercial properties, streetlights and illuminated sporting venues. It is most severe in highly industrialized, densely populated areas of North America, Europe and Japan and in major cities in the Middle East and North Africa like Tehran and Cairo.

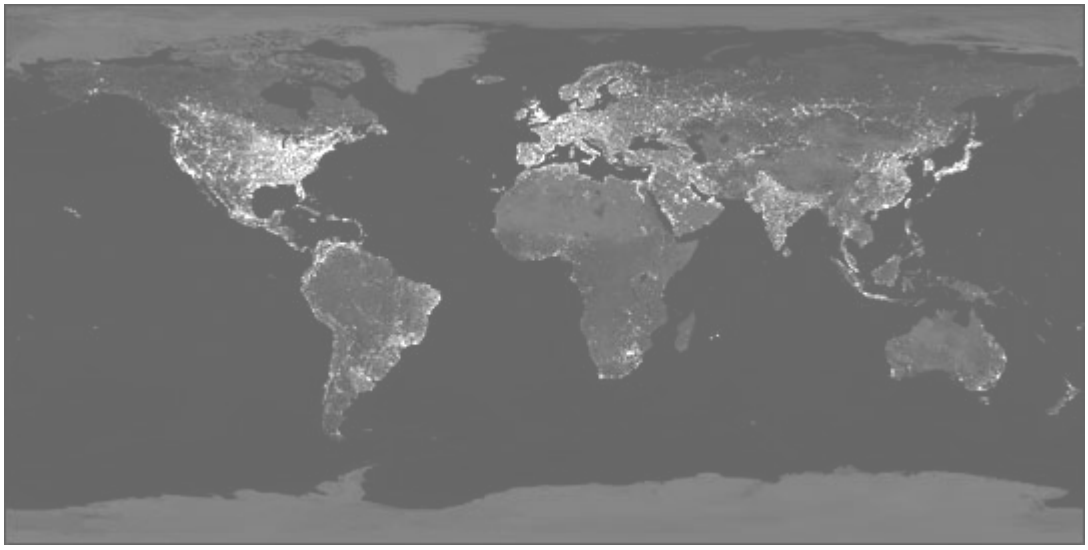


*Photo credit: NASA – T*he Visible Earth (http://visibleearth.nasa.gov/)

Types of Light Pollution

- **Sky glow** – where the light escapes into the night sky causing a glow over urban areas. Light is scattered by clouds and atmospheric particles making stars and other features of the night sky difficult to see. This is of particular irritation to astronomers because it reduces contrast in the night sky to the extent where it may even become impossible to see any but the brightest stars. You may have noticed that stars in cities are more difficult to see than in rural areas – this is because of sky glow.
- **Light trespass** – where unwanted light shines onto a neighbour's property or into their home. A common light trespass problem occurs when a strong light enters the window of one's home from the outside.
- **Over-illumination** – the excessive use of light or presence of lighting beyond that required for a specified activity. A couple of examples are when office buildings that are lit up both exteriorly and interiorly all night, and when interior lights are used when daylight is available.

- **Glare** – when light shines dangerously into people's eyes as they walk or drive by, like when we are blinded by oncoming car lights.
- **Light clutter** – excessive groupings of lights, much like the street of Las Vegas. Groupings of lights may generate confusion, distract from obstacles and potentially cause accidents.

Excess lighting wastes energy; some groups estimate that over-illumination is responsible for approximately two million barrels of oil per day in energy wasted in the United States. It also has health effects – medical research has found that excessive light on the human body may cause increased headaches, fatigue and anxiety. Light pollution also disrupts ecosystems, can confuse animal navigation, change predator-prey relations and cause physiological harm. For example, lights around lakes prevent zooplankton, such as *Daphnia*, from eating surface algae. This results in algae blooms that can kill off the lakes' plants and lower water quality. Other cases occur when migrating birds are disoriented by lights on tall structures, and sea turtle hatchings are confused by artificial lights on the beach and cannot find the ocean.

Dark Sky Preserves and Reserves

Astronomers have been working to protect the night sky. Organizations such as the Royal Astronomical Society of Canada and the International Dark-Sky Association have been collaborating with communities and governments to alter outdoor lighting and to designate areas. Canada has 35 formally recognized dark sky preserves in seven provinces including Nova Scotia, New Brunswick, Quebec, Ontario, Saskatchewan, Alberta and British Columbia. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has developed a Starlight Reserve recognition program aimed at preserving and recovering the night sky.

Unit 6: Food Production

Part of going green is knowing where your food comes from, and potentially growing your own. If you don't know where your food comes from, you should be asking questions about how green your food is. One of the best ways to ensure your food is 'green' is to grow your own.

Canada has a huge agricultural industry. We grow a wide variety of crops that is consumed by Canadians and the rest of the world. In fact, we are one of the largest agricultural producers and exporters in the world. As with other developed nations, the relative contribution of Canadian agriculture to the overall economy has been declining but the absolute size of the sector has continued to grow. According to the Government of Canada, agriculture is an $80 billion a year industry that directly or indirectly employs more than 2.3 million Canadians, and represents about eight per cent of our GDP (Gross Domestic Product). The importance of agriculture as an industry varies across the provinces with food processing being more important in Central and Eastern Canada, and primary agriculture more important in the Prairies. In 2009, total sector export sales reached $35.2 billion, 40.5per cent of which were consumer-oriented products (Government of Canada).

Agriculture as an industry is focused on large-scale production of good quality food. Often this requires the use of fertilizers and pesticides, which can have some environmental impacts. Farmers use fertilizers to enhance crop yields and pesticides to limit the damage done by insects and disease. Through these tools, farmers maximize their crops for their own profit and security, but also provide food needed to feed the world.

Presently, the world produces more than enough to feed everyone. However, that food is not evenly distributed – the world has more than one billion people who are overweight and an estimated 800 million who are undernourished. Global agriculture will have to double its food production by 2050 to feed the world's growing and more affluent population (Fischetti, 2011).

We are blessed in Canada to have an abundant, safe and secure food supply that is relatively affordable. Statistics Canada says that food costs represent just 10 per cent of our annual income, which is one of the lowest costs of food to income ratios in the world.

Just the Facts Ma'am

- The average farm in Canada produces enough food to feed 120 people every day. In our grandparents' or great-grandparents' time, a farm produced enough food for 10 people each day.
- Approximately 3.7 million beef cattle live on Canadian farms. That's slightly more than the entire population of Alberta.
- Canadian farmers raise about 17 million pigs each year. Canada is the second-largest pork exporter after the United States.
- Canada is the largest producer and exporter of flax in the world.
- Canada produces about 85% of the world's maple syrup, most of it in Quebec.
- Agricultural products have numerous non-food uses. A few examples are: airbags in cars contain cornstarch; diabetic test strips use an enzyme found in horseradish; canola oil is part of the compound used to de-ice planes; some shampoo and skin care products have oats.

Genetically Modified Foods

One issue confronting farmers (and consumers) is genetically modified organisms, or GMOs. Until recently, we bred plants and animals to produce different types. We 'selected' for preferable characteristics already present within a species like cattle that yielded more meat or calved easier and wheat that was rust-resistant. This process is called **selective breeding**. **GMOs**, on the other hand, are genetically modified in laboratories to enhance desired traits such as resistance to herbicides, improved nutritional content or increased tolerance to cold.

Opposition to this type of intervention is focused on concerns for human health. Some people refer to them as 'Franken-foods', after Frankenstein's monster. Introducing a gene into a plant may create a new allergen or cause an allergic reaction in those who have developed life-threatening allergies to peanuts and other foods. Or, ingesting GM foods that have an antibiotic feature to make them immune or resistant to diseases may persist in our bodies making actual antibiotic medications less effective and leading to a decreased effectiveness of antibiotic drugs. What if GM potatoes harm our digestive tracts or that the introduced genes carry a substance toxic to mammals? Some of the environmental concerns are that pesticides and herbicides will become less effective, and that genetically enhanced animals and vegetation can create new super-organisms that can out-compete natural animal and plant populations and drive certain species into extinction.

However, supporters of GMOs point to the need to develop plants and animals that are more resistant to disease and that have better production in order to feed the world. Genetically-modified foods have the potential to solve many of the world's hunger and malnutrition problems, and to help protect and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicides

Pesticides

Pesticides are another worry for green folks. **Pesticides** are substances or a mixture of substances intended for destroying or repelling any pest, such as weeds, insects or disease. They can be herbicides, fungicides, insecticides and bactericides. According to researchers at Cornell University, for every dollar that is spent on pesticides, four dollars of crop are saved. Based on the $10 billion per year spent on pesticides, farmers save $40 billion worth of crops that would otherwise be lost due to damage by insects and weeds. Generally speaking, farmers profit from having an increased crop yield and being able to grow a variety of crops throughout the year. Consumers also benefit by being able to afford the vast quantities of produce available year-round. The use of pesticides helps to control insect-borne diseases and illnesses, such as malaria, and finally it creates jobs for all of the people who work within the industry.

Concerns over pesticides focus on potential health hazards. Pesticide exposure can cause a variety of adverse health effects from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems and causing cancer. Environmental concerns include: water pollution as the result of agricultural waste run-off; soil contamination by persistent organic pollutants; pesticide resistance necessitating a new pesticide; and pesticide drift and mortality of non-target species which results in decreased biodiversity, decline in pollinators, and threats to endangered species.

An alternative to traditional farming that uses pesticides is organic farming. This type of farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured or synthetic fertilizers, pesticides, plant growth regulators, livestock antibiotics, food additives and genetically modified organisms. Organic farming relies on techniques such as crop rotation, green manure, compost and biological pest control to produce crops which have the highest nutritional values with the least impact on the natural environment. However, this type of farming has lower yields and requires more labour. Thus the food produced through organic farming is generally more expensive, and some would argue, tastier and healthier. However, a food production system based on organic methods would severely affect the ability to meet the world demand for food.

Food Miles

People have suggested that we should pay attention to food miles if we want to be green. **Food miles** are a way of indicating just how far the food we eat travels from the farm where it is first produced to where we purchase it. It can be used as a crude indicator of the environmental impact of food, including global warming. Apparently, the average Canadian meal travels 2,500 kilometres to our plates and contains ingredients from five different countries!

Upon first blush, we would be greener if we ate more food grown close to home, supporting local farmers and limiting the transport. However, we need to be careful about applying this measure. For example, a recent study by Britain's Department for Environment, Food and Rural Affairs showed that tomatoes grown in Spain and transported to Britain might have a lower carbon footprint than tomatoes grown in heated greenhouses in the United Kingdom.

Another consideration is that the journey from "field to plate" is not always a direct one. The calculation of food miles may not include the actual route of the product – from farm to processor, from one processor to another, from the processors to distribution centres, then to the retailer and finally to our homes. Sometimes these journeys are very long; for example, some fish caught in the North Sea goes to China for processing and then back to retailers in Europe.

Relative distances and mode of transportation further complicate this notion of food miles. Foods that are transported in bulk to a supermarket can have a lower ecological footprint than foods a consumer picks up directly from a farm that is within driving distance but farther away than the store. For example, four litres (just over a gallon) of gasoline could transport five kilograms of meat over 97,000 kilometres (60,000 miles) by road in bulk transport, or it could transport a single consumer only 65 kilometres (30 or 40 miles) to buy that meat. Therefore, the meat supplied to the store through bulk transportation would have less food miles and less of a footprint if the consumer were just a short drive away. If the consumer walked, bicycled, or took public transport to the store, the overall footprint would be even less!

Just like the tomato example, we need to think about the wider environmental costs involved in food production – energy usage, fertilizers, feed and pesticides. It is a complex issue and looking at food just in terms of how far it has travelled risks missing many other equally important things along the way.

100 Mile Diet

Maybe you have heard of the 100 Mile Diet that suggests we try to acquire our food within 100 miles from where we live. It was made popular by a book written by two Canadians, Alisa Smith and J.B. MacKinnon and includes the concept of food miles. The goal of the book was to force us to think about where our food comes from and what is available to us locally.

Following the 100 Mile Diet is easier in parts of Canada that have a milder climate and grow more types of food over a longer period of time. Following the diet is also much easier in the summer when a lot of fruit and vegetables are in season locally. But, if we track the source of our food for one meal, we can find out where our food comes from and what is actually grown close to our homes. That way we can appreciate the bounty of our local region and consider the impact of our choices. We need to ask ourselves if is it 'greener' to buy a locally produced tomato from a greenhouse that has to be heated and that has to use pesticides intensely due the humidity and plants at close quarters. Or, is it better to buy a tomato that had been field grown in a warmer, less humid environment over a hundred kilometres away? Or is the better yet to only eat tomatoes when they are in season?

Beyond the Supermarket

One source of good locally grown food is farmer's markets that are found in many places in Canada. At these markets, producers set up stands to sell vegetables, fruit and sometimes prepared foods and beverages. Here you can find a variety of locally grown food that is usually fresher than the stores. Since you are often buying from the farmers themselves, they could answer any questions on how their products were grown, what pesticides might have been used and provide tips on how to best prepare it.

Growing our own food is the best – we know what it's grown in and what goes on it (if anything). It is fresher than anything we can buy and tastes better too. Some of us are lucky to live on a farm, or have a big yard where we could make a garden. Others of us may not have the space, but lots of vegetables can be grown in pots (see table below). In some communities, community gardens are available to grow vegetables, or even flowers.

Plants that can be grown in pots or containers:

- Bush beans
- Carrots
- Cucumbers
- Herbs
- Lettuce
- Peppers
- Potatoes (in big pot)
- Radishes
- Strawberries
- Tomatoes

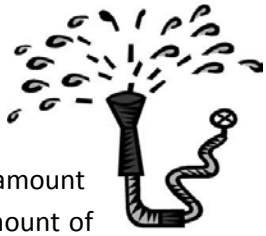
Community garden – a community garden is a single piece of land gardened collectively by a group of people. Is there a community garden in your area? If not, could you establish a community garden in your community?

Developing a Garden

If you have space for a garden in your yard, or at your school, or if you are starting a community garden, there are three approaches:

1. **Traditional 'break the sod and plant a garden'** – This is a common type in an area with good topsoil, particularly in many parts of the Prairies where the top soil can be five to ten inches deep.
2. **Raised bed** – In this type of garden, a frame is built and filled with soil. Generally the frame should be one to 1.2 metres (three to four feet) wide and from 15 centimetres (six inches) to waist height. This is ideal for areas where top soil is thin, where the soil gets wet and water-logged, or where the gardener has trouble bending to plant and weed. A raised bed can extend the season as the soil warms up quicker and can be planted earlier. However, it will also dry out quickly so will require more watering in the dry months.
3. **Lasagne garden** – is a no-dig approach to building a garden and is also known as **sheet composting**. The name '**lasagne**' has nothing to do with what you'll be growing in this garden but refers the layers of material used to build it. Instead of alternating meat sauce, pasta and cheese, you would be alternating green and brown material. Basically the garden is started by laying down a heavy layer of cardboard or newspaper and then layering nitrogen-rich materials like kitchen waste, weeds, lawn clippings and carbon-rich materials like leaves and paper to create a two-foot high layered bed. This will break down quickly and produce nutrient-rich, crumbly and easy-to-work soil. It is essentially building your garden by composting.

Water



In many parts of Canada, how we use and manage water is a critical element of being green. In the garden, water is the most important ingredient. Since most plants are 90 per cent water, it is essential for cell structure, stability and growth. Too little, too much and too irregular are all bad for plants. The amount of water depends on the soil type, available sun, stage of growth and the amount of rainfall. Watering should be done thoroughly and deeply with the best time being early morning to avoid evaporation that happens during the day, and mildew and diseases from watering at night.

Watering by hand can be water-saving but can be very time-consuming. Sprinklers give good coverage and are time-saving but water on the leaves of the plants can lead to diseases like mildew. As well, it is easy to overwater with sprinklers, or lose water to evaporation and wind. A soaker or weeper hose gets water right to the roots of the plant without getting on the leaves. The downside is that it is difficult to know how much the plants are getting. A drip irrigation system is the most precise as it gets water to each individual plant. It cuts down on water use and, like the soaker hose, will keep the plant leaves dry, helping keep plants disease-free.

In some parts of Canada, and particularly in summer, water can be scarce and expensive when you have to pay for it by either trucking or through a municipal water system. Many people collect rainwater when it is abundant and store it in rain barrels or cisterns for use on gardens and lawns during dry periods. This collection and storage of rainwater that would normally flow off the roof is good for plants, as rainfall does not have the minerals and chemicals found in groundwater or water from municipal water systems. It is uncontaminated and is full of nitrogen from the atmosphere. In towns and cities, this collection will also reduce storm water run-off thus keeping pollutants like oil, street toxins and sediments out of natural systems.

Check out this website for great advice, tips and answers: www.rainbarrelguide.com

Another source of water is **greywater**, which is all household wastewater from kitchen sinks, dishwashers, laundry tubs, washing machines, showers, baths and basins. Note that this does NOT include the toilet water, which is known as **blackwater** and should NOT be used. Greywater is a great source of water and nutrients if it has not been polluted with non-degradable chemicals such as non-natural soaps.

Another way to conserve water is not to use it. You may ask 'how does that work'? Well, it is a matter of using water-wise plants, or **xeriscaping**. Note that this does not generally apply to vegetable and fruit plants, but to ornamental plants. Water-wise plants are adapted to local conditions and, therefore, generally grow better, require less maintenance and use less water, fertilizers and pesticides. These plants develop extensive root systems to effectively gather water and are more drought-tolerant. In planning a water-wise garden, you will need to consider your climate, microclimates and soils. You can search the Internet for xeriscaping information and resources specific to your location.

Another way of being green in the garden is to use mulch to help retain soil moisture once it is there. Mulch has the added benefit of suppressing weeds and adding fertility. You can use organic residues like untreated grass clippings, leaves, hay, straw, shredded bark, whole bark nuggets, sawdust, shells, woodchips, shredded newspaper, cardboard, wool, leaf mulch and pea straw. These materials should be kept at least an inch away from plant stems to avoid rot and fungus problems. Inorganic mulches like clear, black or coloured plastic, polyester garden fabrics, gravel or stone or carpet remnants can also be used. However, you may want to keep in mind how these materials were produced and if you are contributing to another environmental issue like pollution of our air by using them.

Composting

Just about any "greenie" composts. **Composting** is a process that involves recycling, reusing and reducing. Natural organic materials are recycled by little organisms into nutrient-rich soil which gardeners and landowners

reuse to build fertility and have healthier plants. By doing this, the need for artificial fertilizers is reduced as well as the space needed for landfills for our organic wastes. This is quite a savings, particularly since approximately a third of household waste is unwanted food and yard materials! Through composting, we also reduce problems with methane, hydrogen sulfide and leachates that green material create in landfills. Best of all, compost increases the soil's organic matter content, its moisture-holding capacity, its porosity and helps plants develop a sound root structure and enhances plant and flower growth.

There are three types of composting:

1. Traditional composting using a bin.
2. Vermiculture using a bin with worms.
3. Compost tea.

Traditional Composting

In this method, the composting organisms or microorganisms require four equally important things to work effectively – carbon, nitrogen, oxygen and water. High carbon materials tend to be brown and dry like leaves, where as high nitrogen materials tend to be green, colourful and wet such as fruit and vegetables. The organisms need air to do their water, and water in the right amounts so that it is not too wet, nor too dry. You can use a pile, a box or a bin. The composting process can take from two months to two years, depending on the materials you use and the effort you put into it. Compost is ready to be used when it is dark and rich in colour, crumbly and has an "earthy" smell.

The activity guide will give you more information on how to set up this type of compost.

Vermiculture

The second type of composting at home is worm composting or **vermiculture**. It produces both worm castings and worm tea. The **worm castings** are nutrient-rich organic soil conditioner and plant food, the **worm tea** is the liquid harvested from the compost which is excellent fertilizer when diluted with water.

Vermicomposting is typically done in a covered container with a bedding of dirt, newspaper or leaves. Fruit and vegetable scraps are added as food for the worms – which eat their weight in organic matter each day! Over time, the food and the bedding will be replaced with worm castings.

Once it is set up properly, it requires very little space or effort; it is self-contained and nearly odourless, and just as long as you put in the right things, it will never smell or attract bugs. The best thing is it can be used in the winter as the worms don't sleep when kept indoors. As this type of composting requires less space than traditional system, it is ideal for classrooms, workplaces, apartments and high-density urban areas where it can be stored under a sink in the kitchen or on a deck. Some schools and workplaces bottle their worm tea in discarded milk jugs and sell it as a fundraiser.

Compost Tea

Compost tea is a liquid fertilizer that can be made by fermenting finished compost in a bucket with water for 24 hours to 14 days. This can also be done with manure or even fish skeletons, which are a potent brew and has a seriously strong smell. However, plants love it! The key to all these is to mix every day then strain the solids from the liquid. The liquid is the tea and great for plants and veggies that flower – broccoli, tomatoes and peas but not lettuce, spinach and turnips which you don't want the plant to flower and fruit.

Growing Your Own

Once you have decided whether to develop a garden bed or use pots, try growing some vegetables, and literally enjoy the fruits of your labour! Some, like radishes, will take as little as 20 days to produce something for you to eat. Others, like corn, normally take 65 to 70 days.

Making Your Own

Once you have grown your own or visited a farmer's market, you can preserve the goodness of summer to eat during times when fresh produce and food is not so plentiful. **Food preservation** is the process of treating and handling food to stop or slow down food spoilage and allow for longer food storage. This includes freezing, drying, pickling and canning or bottling.

Freezing is one of the easiest methods of preserving food, but relies on having a freezer in which to store your goods. Before being frozen, some produce should be **blanched** – plunged into boiling water, then into plunged into very cold water to stop the cooking process. This will help to preserve quality by destroying enzymes that can alter colour, texture and flavour during storage. Others, like most fruits, can be quite simply bagged and frozen.

Drying is one of the most ancient food preservation techniques, and reduces water content to prevent bacterial growth. Open air-drying using sun and wind is one of the oldest methods, but pesky flies are hard to keep away. A solar or electric food dehydrator, or even an oven on low temperature, can greatly speed the drying process and ensure more consistent results. Many kinds of fresh fruits, vegetables, herbs, meats and fish can be dried. Fruits are easier to dry than vegetables because moisture evaporates more easily, and not as much moisture must be removed for the product to keep. Certain foods such as lettuce, melons and cucumbers are not suitable for drying because of their high moisture content, and others like carrots are easily stored for several

months in a cool, dry basement or cellar. You might want to try making fruit "leathers," which are a tasty variation of dried fruits. They are made by puréeing almost any type of fruit, then spreading the purée on a cookie sheet or similar tray to dry. See your activity guide for more information.

Pickling is a method of preserving food in a high-acid solution, either by adding an edible chemical like vinegar or, naturally by fermentation. In chemical pickling, the food such as cucumbers, peppers, herring and even eggs are placed in brine, vinegar, alcohol or vegetable oil that serve to inhibit or kill bacteria and other micro-organisms. Many chemical pickling processes also involve heating or boiling so that the food being preserved becomes saturated with the pickling agent. Pickles such as dill, bread and butter, and relish are made this way. Even carrots, beans and asparagus can be pickled! In fermentation pickling, the food itself creates the preservation agent, typically by a process that produces lactic acid. Fermented pickles include sauerkraut and kimchi which is Korean fermented vegetables.

Canning involves cooking food, sealing it in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria. Since foods have varying degrees of natural protection against spoilage, some may require that the final step occurs in a pressure cooker. High-acid fruits like strawberries require no preservatives and only a short boiling cycle, whereas marginal fruits such as tomatoes require longer boiling and the addition of other acidic elements like vinegar. Low acid foods, such as vegetables and meats, require pressure canning. Once the can or bottle has been opened, the preserved food can start to spoil. It is important to follow the correct procedures or you run risk of your food spoiling, or worse, introducing a bug that produces a serious toxin known as botulism that can lead to severe illness or death. To ensure food safety, use up-to-date recipes and measure ingredients carefully.

Discussion Point: What are some other things that you can make?

Another part of being green is to prepare our own food. Pre-prepared convenience foods not only have a lot of packaging but they also have a lot of added extras to extend shelf life or to enhance flavours. Highly processed foods typically contain unhealthy levels of fats, sugar and salt, and can be low in nutrition. A diet comprised only of processed foods is likely to lead to obesity and chronic disease. Convenience foods have also reduced our awareness of, and relationship to, the food chain and our local environment. Preparing and cooking our own food allows us to know exactly what we are eating and reducing waste. It is another step to being green.

A whole movement has sprung up due to concern about fast food and big business taking over our food. It is called **the Slow Food Movement** and it aims to preserve cultural cuisine and in doing so to preserve food plants, seeds, domestic animals and farming within a region. It encourages us to partake in the pleasures of food growing, preparation and consumption among friends and family.

This way we assist in developing and maintaining a greener and sustainable local economy which is healthier and which respects cultures and the earth's resources. The Slow Food Movement is also dedicated to preserving and promoting traditional foods, recipes and the pleasures of eating well.

We have also seen a resurgence of interest in cooking and baking, and all sorts of food preparation. For example, making our own pasta, baking pizza and breads in an outdoor open and even creating cheese. The activity guide will help you in pursuing some of these activities. 4-H has a number of cooking projects if you are interested in learning more.

Unit 7: Making Green Choices

We have a number of opportunities to green our lives. We have discussed many of them in the units on energy, waste, water and air. Generally, being green is about making choices that have less impact, are more sustainable and greener. One activity where we make many choices is shopping – and there's lots of opportunity to make green ones!

Just like concern for our food, more people are becoming concerned about our ecological footprint as a result of other products we are buying, the choices we are making. What is it doing to the environment? What are the health effects?

Certification

One of the best ways to know that you are making good green choices is to select items that display some sort of certification. One of the keys to any certification program is **a third-party audit** – or someone who is independent, who can substantiate the claims being made. In addition, if the certification has an ISO number, it means that it met specified environmental performance criteria or standards according to the International Organization for Standardization (ISO), one of the world's largest developers and publishers of international standards. We will discuss some of the more common ones but more are coming on stream as concern and interest grow.

With the consumers' increasing interest of, and demand for, being greener, manufacturers and producers have responded. We see many green products in the stores – but how green are they really? We need to be cautious and careful in selecting these items in order to avoid green wash. **Green wash** is the act of misleading consumers to promote the perception or idea that a company is environmentally friendly. True **green products** are those that focus on reducing waste and environmental impact. They follow strict guidelines in order to be certified as green. One way to tell if something is truly green is to look for an eco-label. To be able to display the eco-label, a product should:

- Be energy efficient.
- Have packaging (or the product itself) that has recycled content.
- Not contain or release any highly toxic compounds.
- Be easily recycled or reused.
- Be biodegradable.
- Be made from a natural/renewable resource.

Note that the CFL light bulbs that we talked about in the Energy Conservation Unit may be energy efficient, but because of the mercury in the bulb, it does not qualify for an eco-label.

Why do green products matter? Let's look at cleaners – have you ever used a cleaner and ended up coughing? As we learned in the Air Pollution Unit, some cleaners contain chemicals or volatile organic compounds (VOCs) that are good at cleaning but that are harmful to us and our environment. When you spray these chemicals in your home, they become part of the air you breathe, so you are inhaling toxic chemicals. Cleaners with a recognized eco-label do not have those toxic VOCs.

In North America, **EcoLogo™** is a widely recognized and respected environmental certification program, both in North America and internationally. EcoLogo™ is one of only two Type I eco-labelling certification programs in North America, as defined under ISO 14024. When you see this label, you can be assured that the products and services bearing the logo meet stringent environmental standards that have been verified by a third party auditor. EcoLogo certifies a variety of products and services, including household and industrial cleaners, laundry detergent, paper, tissues and napkins, paints, fuels, office furniture, printers, flooring and other renovation and building supplies.

Similarly, organic foods that are billed as organic may not be. The Canadian government has established federal certification for agricultural goods to be called organic. To display the ***Canada Organic logo***, organic growers and producers must be certified by a third party auditor that they are following the *Organic Products Regulations* and their product contains at least 95 per cent organic ingredients.

What about building materials? Are they coming from forests that are managed in an environmental and sustainable way? It is very important to the people in Europe who buy Canadian forest products. So federal, provincial, territorial and municipal governments in Canada have supported forest certification as a tool for improving performance and demonstrating the country's sustainable forest management, ethical behaviour and adherence to laws at all points from planting to processing. Businesses using these certification systems must pass annual audits that are publicly reported and must involve the public at some level. Nearly 90 per cent of Canada's working forests are certified and follow one of three internationally recognized certification systems:

1. **Canadian Standards Association (CSA)** – has worked with a diverse range of stakeholders to develop Canada's National Standard for Sustainable Forest Management (SFM) CAN/CSA-Z809. As of June 2007, about 59 per cent or 79.3 million hectares out of 134.1 million hectares of certified Canadian forests had been certified under this standard.
2. **Forest Stewardship Council (FSC)** – evaluates forest and forest management and tracks wood, paper and other forest products to the consumer. These are identified by the FSC logo.

3. **Sustainable Forestry Initiative® (SFI**) – bases its program on principles and measures that promote sustainable forest management and consider all forest values. It is the largest single forest standard in the world.

As with other products, a number of valid fish certification programs exist.

1. **Marine Stewardship Council** – has an international certification program to meet standards for sustainable fishing and seafood traceability. Through their distinctive blue label, consumers can purchase seafood caught through sustainable fishing practices. This in turn, encourages more fishing companies to undertake sustainable fishing practices.
2. **SeaChoice** – is Canada's most comprehensive sustainable seafood program. Based on scientific assessments, SeaChoice has created easy-to-use tools that help us, the consumer make the best seafood choices and thus support sustainable fisheries and aquaculture at all levels of the seafood supply chain. http://www.seachoice.org/wp-content/uploads/2012/04/SC_card_2012_5panel_web.pdf

Gifts

Another common item that we make choices about while shopping are gifts. Every December, we spend large amounts of money on gifts. In 2009, sales of sporting goods were up 130 per cent from average monthly sales; consumer electronics up 150 per cent; toys and games up 232 per cent! How do we make greener choices when we are selecting a gift? What should we give someone that has everything? What should we wrap it in? We can consider buying "green" gifts, package them in a "green" way and choose more environmentally friendly alternatives.

If we want to give an actual physical gift, here are some things to keep in mind:

- Avoid plastics, polyesters, vinyl, hardwoods or any other non-sustainable materials. Many of these materials are not easily renewable and/or may produce toxins either in their manufacturing or during use.
- Try to avoid plastics; look for natural materials such as cotton, bamboo, wool and wood.
- Be careful with kids' stuff. Looks for high-quality toys that will last. Look for non-toxic paints on gifts like wooden toys.
- Look for a certification, or a valid eco-label.
- Instead of buying things that *are* green, buy things that teach green. For example, a vegetable gardening book, shade-grown coffee.
- Give a voucher to the local "green" shop so your recipient can shop for their own green gift.
- Wrap your gift with newspaper, coloured comics, a spare map or scrap cloth material. Use recycled paper from last season or "almost-new" gift. Instead of ribbon, use wool or string.

Gift of Re-giving – Something else you might want to consider is re-gifting. Sometimes we receive gifts that, hmmm, aren't really "us". We all can think of gifts that although they were nice, they weren't something we'd use or wear – that bottle of bubble bath or that pink T-shirt. Today, it is acceptable to use the gifts that we receive to give to someone else. Key here is that you need to remember who gave it to you so you don't give it back to them. That would be a big oops!

There are some alternatives to giving physical gifts:

Gift of Experience – Sometimes the actual doing of something is better than a physical gift. Give a gift certificate or ticket for a local service, event, outing, film, workshop or course; buy a family membership or tickets for the zoo; give a voucher for a train or boat trip.

Gift of Time – For many people, particularly adults, time is precious and the gift of your time can be worth more than an expensive present. Babysitting, dog sitting, vacuuming, cleaning, washing the car are all good gifts of time. For a younger person, you could offer do their favourite activity like go for bike ride, horseback riding, play a game.

Gift of Talent – Talent covers so many things. If you can paint, crochet or knit, or take nice photos, you can give a gift of talent. You could write a letter, poem, song or short story, or make another creative/artistic gift. Many, particularly parents and grandparents, treasure homemade gifts. You could make your own cards, or make your own paper to make your own card. It doesn't have to be complicated – it could be homemade cookies, cakes or pies. Just be sure when making an edible gift, that you check allergies or dietary restrictions!

Gift of Gratitude – Sometimes we don't take the time to recognize and thank people for what they mean to us. Write letters to the people you value in your life and tell them why you appreciate them.

Gift of Charity – Many groups out there do incredible works and rely on gifts of charity or donations. It is perfect for the impossible-to-buy-for people on your list. You could donate locally or help an international charity that is providing water supplies or solar cooking devices for Africa. Check out the Give Green Canada website for ideas. This website has been set up by Tides Canada which is a national charity dedicated to our environment and people. It's a network that connects donors with doers. http://www.givegreencanada.ca/home?&ref=donors

Many organizations have gift donation programs where you donate some money to support their activities like purchasing property, planting trees or funding research, and your recipient will receive a card, certificate or indication that a gift has been given in their name. Organizations like the World Wildlife Fund, World Vision and UNICEF have many projects that are funded this way. Even the Vancouver Aquarium has an "Adopt a BC Wild Killer Whale" where the money you give to adopt a whale is used to study killer whales in the wild.

Unit 8: Our Natural Environment

Canada is a large, ecologically diverse country of exceptional natural beauty and richness. It borders on three oceans and contains vast areas of boreal and temperate forests, mountains, tundra and prairie grasslands. These areas support numerous human activities such as agriculture and forestry upon which the country's economy heavily depends. While some activities leave no impact and others help restore ecosystems, generally the integrity of Canada's natural environments is threatened by many kinds of human activities.

To ensure the continuing existence of our natural ecosystems and wild areas, our governments have legally protected some areas from resource extraction and settlement. These protected areas are composed of land, freshwater and marine areas set aside through legislation to protect ecosystem components and functions, to provide refuge to endangered species of plants and animals, and to serve as natural gauges against which human land uses and changes to ecosystems can be measured. In addition to conserving land and sea for future generations, protected areas also play an important role in the social and economic development of the country. They provide economic benefits to nearby communities and to Canada as a whole; they act as places of education; and they promote recreation and the health and well-being of the population.

Canada has a long history of establishing protected areas. The first such area, Banff National Park, was created in 1885. In the last decades, Canada has substantially increased the number of its protected areas. These areas include, but are not limited to, national and provincial parks, wildlife sanctuaries and ecological reserves. Non-government organizations such as the Nature Conservancy of Canada have also purchased land for those purposes.

According to the Canadian Council of Ecological Areas, 9.8 per cent of Canada is protected in 5,852 areas. They cover 991,150 hectares, which is bigger than the country of Hungary.

Parks and Protected Areas of Canada 2010. Source: Nature Canada website
http://naturecanadablog.blogspot.co.nz/2010/07/parks-day-in-2010-celebrating-new.htm

National parks, national wildlife areas, migratory bird sanctuaries and marine protected areas are managed by the federal government, and make up 50 per cent of the land in all of Canada's protected areas. National parks are "…dedicated to the people of Canada for their benefit, education, and enjoyment… Such parks shall be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations". Migratory bird sanctuaries protect migrating species, national wildlife areas protect the habitat of migratory birds and other species, and marine protected areas serve to protect and conserve important fish and marine mammal habitats, endangered marine species, unique features and areas of high biological productivity or biodiversity.

Provincial parks are more numerous but smaller than national parks. They are established for our recreation and education, environmental representation and protection of special natural and cultural features. Other provincially protected areas, such as ecological reserves and wilderness areas, are established mainly to conserve their natural characteristics and wildlife and are not generally accessible to the public.

Some of the protected areas are part of a network of international conservation initiatives, such as UNESCO World Heritage Sites, Wetlands of International Importance (Ramsar Sites) and Biosphere Reserves. For example, the national parks of Banff, Jasper, Kootenay, and Yoho along with the provincial parks of Mount Robson, Mount Assiniboine and Hamber have been designated as the Canadian Rocky Mountains World Heritage Sites. Delta Marsh in Manitoba and Point Pelee in Ontario have been designated as a Wetland of International Importance, and Southwest Nova in Nova Scotia and Clayoquot Sound in BC have been designated as Biosphere Reserves. In total, Canada has 16 World Heritage Sites, 37 Rasmar sites and 12 Biosphere Reserves.

Non-government organizations, such as the Nature Conservancy of Canada, the World Wildlife Fund and Ducks Unlimited, are international organizations that are active in Canada. They work to conserve species at risk and protect threatened habitats. They collaborate with citizens and governments to help conserve important habitat and promote sustainable use of resources. Some of these organizations have purchased private properties in order to protect key natural, recreational and cultural features.

Discussion Point: What are the national parks and provincial parks in your area? Do you know why they were established? Do you have any other protected areas – national wildlife areas, ecological reserves and marine protected areas – near you?

Restoration

Both inside and outside protected areas, environments have been degraded, damaged or destroyed. However, with effort, some of these can be restored through species and habitat recovery programs. Protected area managers, fish and wildlife staff and environmental agencies undertake activities to return a damaged ecological system to a stable, healthy, functioning natural ecosystem. Restoration covers a wide scope of projects including: erosion control, reforestation, the use of genetically local native plants, removal of non-native species and weeds, revegetation of disturbed areas, re-introduction of native species and habitat improvement for certain species.

Sometimes these areas can naturally recover by themselves, such as a pine forest after a fire. Others require active management – like the removal of introduced species, replanting native plants and re-introduction of native animals. These activities can help restore habitat for threatened or endangered species, improve visual impacts and even help to reduce climate change by planting trees that will absorb carbon dioxide. However, not all restoration projects work, and sometimes, the project would be so expensive that is just not possible to undertake it.

Daylighting streams have been successful projects. Streams that had been culverted, paved and built upon as part of urban development are now being uncovered and restored back to a natural state with plants and animals. Buried streams are dead streams as they don't usually support fish or other aquatic life, and they don't provide resources or habitat for other plants and animals. A good example is a stream near Spanish Banks in Vancouver that has been daylighted and now has three species of spawning salmon using it! These streams and creeks are also attractive to urban residents as green spaces and natural areas.

Island restoration programs are another type of project. These focus on the removal of predators like fox, rats, mink and ferret from islands that support seabird colonies. These pests were often

introduced in the first place and ending up destroying nesting colonies. As part of the restoration, the seabird species are frequently re-introduced.

Many of these projects depend on volunteers to undertake much of the "grunt" work. This assists in keeping costs down, creating an awareness of local environmental issues and engaging the community. These people often became "wardens" to look out for, and protect, the area and report any negative changes that may occur.

Here is a list of common activities that volunteers like clubs, groups and schools undertake:

- Planting of native plants, trees and shrubs to increase biodiversity and to re-introduce native species that have been lost.
- Planting of native tree seedlings to stabilize river banks and create shade.
- Planting of shelterbelts to provide shelter from the wind and to protect soil from erosion.
- Remove invasive plant species.
- Install nesting structures for native birds.
- Building and installation of bat houses.
- Creating bee boxes for insects that help pollinate plants.
- Clean up of debris and illegal dumpsites.
- Beach clean-up.
- Addition of spawning gravel to the streambeds for fish.
- Fencing off stream and wetland areas from cattle.
- Collection of native seeds.

Unit 9: In Our Community

Hopefully through the course of this project, you have learned a lot about going green, and you have made some changes in your life to reduce your ecological footprint and be green. We as individuals can reduce our footprint. If we can inspire others to do so similarly, we can start making great strides in reducing our impact and conserving our resources. Research has found that many people do care about the environment but they often believe that others don't care and they feel like they can't make a meaningful impact alone. One of the most powerful ways of helping shift our society towards being greener is to engage others and show that small efforts have big results as they add up. In this collective effort, an energy can grow that becomes greater than the sum of its parts. This is known as **synergy**. This unit focuses on creating a "green synergy" in your club and community.

Many people are concerned about the health of our environment. They talk about doing something but don't do anything. This is called 'talking the talk'; it is just talk. Let's move people from talking to doing – from talking the talk to walking the walk!

Walk the Talk

Lead by example – By undertaking the activities of this project, you have taken the first step to show your community that talk can be put into action. By doing more of them and continuing them after Achievement Day, you are truly walking the talk. Sometimes, you may have a few stumbles on your walk but the key is that you keep walking; you are actively doing something to reduce your ecological footprint and helping to make the world a greener place.

Support businesses that have green business practices or stock local or green products – A business can only survive with the support of its customers. By choosing businesses with good practices or buying green products, you are helping to raise standards, stimulate sustainable business practices and create a market for green products.

Feedback – If you refuse to buy a product or support a business because of their practices, let them know. Write, email or call companies to let them know that you refused to buy their product because it was over-packaged, or it had too much fragrance, or it was not eco-certified. If a business has too big a footprint, let them know your concerns. Conversely if a business has good practices, let them know. Showing interest lets businesses know that their customers care about these issues and encourages change.

Talk the Walk

Education and Information – Often people in our clubs and communities just need to have some information on 'why' the walk needs to happen, or 'how' they can do it. We need to 'talk the walk'; we need to provide people information on why and how to be greener. For many folks, recycling can be just too inconvenient. By giving them reasons why it is good to recycle, what can be recycled and how to do it, they may just convert to recycling.

Providing information could be done a variety of ways from written leaflets, to infomercials on your local cable station, to posters, to mall displays, to workshops. You could provide just about any of the information you have learned in this project thus far – calculating ecological footprints, doing energy audits, ways to conserve water quantity and quality, the 'R's of being green, green certification, composting, gardening, preserving and more!

Walk the Walk

Advocacy – Demonstrate your support for the environment publicly. If your community has limited recycling, encourage your local politicians, council members and company leaders to expand it. Just don't highlight the issue, but help them to find solutions. Why is there only limited recycling? What can you, or your group, do to help expand? Is it more bins?

Join one of the many local environmental groups in your area that fit with your philosophy. If there isn't one, consider starting one.

Community involvement – help your community to walk the walk. Consider organizing a community event or project to help your community be "greener". You could consider the following:

- Organize a beach clean-up.
- Co-ordinate a restoration project. Check with your local wildlife federation, environment agency or even town to see what needs to be done – a tree planting program in an area that needs more trees, invasive plant removal or a roadside clean-up.
- Start a community curb-side composting program.
- Arrange a fundraiser to buy trees for planting.

Another way to engage and encourage your community is to organize an event around one of the many days established to raise awareness for various issues – environment, wetlands, oceans, birds. Below is a chart of just some of the events that are recognized internationally or nationally:

This is your opportunity to go green and walk the walk! The world is depending on you, and all of us.

Event	Day	Objective
Buy Nothing Day	Last Friday in November	To draw attention to the issue of over-consumption. http://www.buynothingday.org/
Canada's Parks Day	Third Saturday of July	To showcase Canada's parks and historical sites through numerous events taking place throughout the country. http://www.parksday.ca/eng/index.html
Canadian Clean Air Day	Wednesday of Canadian Environment Week	To raise awareness and encourage action on clean air and climate change issues. https://www.ec.gc.ca/sce-cew/default.asp?lang=En
Canadian Environment Week	Week of June 5	To celebrate the progress that has been made to preserve, protect, and restore our environment and encourage further efforts all year long. http://www.ec.gc.ca/sce-cew/default.asp?lang=En&n=69DF79A5-1
Canadian Rivers Day	Second Sunday in June	Celebrated alongside Oceans Day during Rivers to Oceans Week. Promotes Canada's waterways.
Commuter Challenge	June 3-9	Nation-wide event that promotes friendly competition among organizations and cities to see who can get the highest percentage of employees out of single occupancy vehicles and into healthier and cleaner modes of commuting such as walking, cycling, transit, carpooling, vanpooling and teleworking. http://commuterchallenge.ca/blog/
Earth Day	April 22	Global movement to increase awareness and appreciation of the Earth's natural environment. http://www.earthday.ca
Earth Hour	Last Saturday of March	Worldwide event to raise awareness about the need to take action on climate change encourage households and businesses by turning off their non-essential lights for one hour. http://www.earthhour.org/
International Day for the Preservation of the Ozone Layer	September 16	Proclaimed by the United Nations to commemorate the date of the signing, in 1987, of the Montreal Protocol on Substances that Deplete the Ozone Layer and to encourage activities to protect the ozone layer. http://www.un.org/en/events/ozoneday/
International Day of Biodiversity	May 22	Proclaimed by the United Nations to increase understanding and awareness of biodiversity issues. http://www.biodivcanada.ca/default.asp?lang=en&n=0B34ACE4-1
International Migratory Bird Day	Second Saturday in May	International education program that highlights and celebrates the migration of birds between nesting habitats to non-breeding grounds. http://www.birdday.org/
National Wildlife Week	The week of April 10	To raise awareness for the conservation of wildlife. http://www.cwf-fcf.org/en/action/awareness/national-wildlife-week.html
Rivers to Ocean Week	The week after the second Sunday in June	To create an understanding of Canada's watersheds, our connection to fresh- and salt-water environments and what everyone can do to protect and keep watersheds healthy for people and wildlife. http://www.cwf-fcf.org/en/action/awareness/rivers-to-oceans/
Waste Reduction Week	Third week in October	To raise public consciousness about waste and its environmental and social ramifications in order to educate, engage and empower Canadians to reduce waste through provision of access to relevant information, opportunities and options. http://www.wrwcanada.com
World Environment Day	June 5	Designated by the United Nations to stimulate action on the environment and empower people from every corner of the globe to become active agents of sustainable and equitable development. http://www.unep.org/wed/
World Ocean Day	June 8	To raise public awareness of the beauty of oceans and of the need to protect our seas and coasts from pollution. http://www.worldoceansday.ca/
World Water Day	March 22	To promote public awareness related to conservation and development of water resources. http://waterday.org/
World Wetlands Day	February 2	To raise public awareness of the vital functions wetlands perform and to promote wetland conservation. Marks the signing of The Convention on Wetlands of International Importance that took place in Ramsar, Iran on February 2, 1971. http://www.ramsar.org/cda/en/ramsar-activities-wwds-wwd2012index/main/ramsar/1-63-78%5E25324_4000_0__

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Glossary

100 Mile Diet – the buying and eating of food that has been grown, manufactured or produced entirely within a 100 mile radius of the residence of the individual who will be consuming the food.

–A–

Acidification – the decrease of pH in water.

Acid rain – rain with increased acidity that is caused by environmental factors such as atmospheric pollutants.

Advocacy – active support, especially the act of pleading or arguing for something.

Aerodynamics – a science that deals with the motion of fluids (as air) that are gases and with the forces acting on bodies exposed to them.

Aerodynamic drag – energy used to move air out of the way as an object (vehicle) goes through space.

Agriculture – the science or occupation of cultivating the soil, producing crops and raising livestock.

Air barrier – a membrane that controls air leakage into and out of the building envelope.

Air quality – healthiness of air.

Alkalinity – pH values above 7; opposite to acidity.

Alternative energy – energy sources that are not one of the major energy sources currently used such as nuclear, hydro or coal.

Alterative fuels – fuels that are derived from sources that do not use up natural resources or harm the environment.

Anaerobic – occurring in the absence of free oxygen.

Aquatic – growing, living in or often found in water.

Asbestos – grayish mineral that easily separates into long flexible fibres. Does not conduct electricity, is chemically resistant and fireproof.

Asthma – a condition that is marked by difficulty in breathing with wheezing, a feeling of tightness in the chest and coughing.

Atmosphere – a mixture of nitrogen, oxygen, carbon dioxide and other gases that surrounds the Earth.

–B–

Bactericides – chemicals used to kill bacteria.

Benchmark – a standard by which something can be measured or judged.

Benzene – a colourless flammable liquid that evaporates easily. Used to make or dissolve other chemicals or as a motor fuel.

Beryllium – a high-melting, lightweight, steel-gray metallic element. Corrosion-resistant and rigid so used as an aerospace structural material, as a moderator and reflector in nuclear reactors, and in a copper alloy used for springs, electrical contacts, and non-sparking tools.

Bioaccumulate – to build up within the tissues of organisms.

Biodegradable – capable of being broken down into harmless products by the action of living things such as bacteria.

Biodiesel – a type of biofuel typically made from: soybean, canola or other vegetable oils; animal fats; or recycled grease. Can be blended with regular diesel fuel and used in most diesel engines.

Bioenergy – energy produced from a biological material in solid, liquid or gaseous form, such as wood waste.

Biofuel – a type of fuel produced from plants and animals such as wood, crops or other forms of biomass. Examples include ethanol, biodiesel and biogas.

Biomagnification – the increasing concentration of a substance, such as a toxic chemical, in the tissues of organisms at successively higher levels in a food chain.

Biomass – material that comes from living things, including trees, crops, grasses, animals and animal waste.

Bisphenol A (BPA) – a harmful chemical found in the linings of food and drink cans, cash register receipts and reusable sports bottles made from hard plastic.

Biosphere reserves – areas of terrestrial and coastal ecosystems promoting solutions for balancing conservation of biodiversity with its sustainable use; part of the world network established by UNESCO.

Blanched – plunged into boiling water, then plunged into very cold water to stop the cooking process. Used in preparing foods for freezing.

Blackwater – wastewater containing fecal matter and urine. Also known as brown water, foul water or sewage.

BPA – Bisphenol A.

Brominated fire retardants – mixtures of man-made chemicals that are added to a wide variety of products to make them less flammable.

Bronchitis – inflammation of the bronchial tubes.

Brown materials – in composting, organic materials high in carbon that are a source of energy for the compost microbes such as leaves, straw, hay and sawdust**.**

Built-in obsolescence – the conception, design and production of a product, such as hardware or software, with the intent that it should be useful, functional or popular for a limited length of time. Also known as 'planned obsolescence'.

–C–

Cadmium – a soft, bluish-white metallic element occurring primarily in zinc, copper and lead ores. Used in low-friction, fatigue-resistant alloys, solders, dental amalgams, nickel-cadmium storage batteries, nuclear reactor shields and in rustproof electroplating.

Canadian Shield – a vast horseshoe-shaped area around Hudson Bay covering eastern and central Canada, and a small part of the northern United States. Also called the Precambrian Shield or the Laurentian Plateau.

Canning – the process of packing prepared vegetables, fruits or meats into specially-made tempered-glass jars, then processing with high heat to ensure food safety and an airtight seal.

Capping – placing a barrier between the landfill material and the surface to seal away harmful contents and restrict surface water infiltration to reduce the potential for contaminants to leach from the site.

Carbon dioxide (CO_2) – a heavy colourless gas that is formed by the burning and breaking down of organic substances (as in animal respiration); dissolves in water to form carbonic acid, and is absorbed from the air by plants in photosynthesis. Has many industrial uses.

Carbon dioxide equivalent – a unit of measurement that can be used to compare the emissions of various greenhouse gases based on how long they stay in the atmosphere and how much heat they can trap.

Carbon footprint – the total amount of greenhouse gases that are emitted into the atmosphere each year by a person, family, building, organization or company.

Carbon monoxide (CO) – a colourless odourless very poisonous gas formed by the incomplete burning of carbon.

Caulk – to fill up a crack, seam or joint so as to make it watertight.

Cavity – a hollow place.

Certification – a guarantee to be true or valid or as claimed or meeting a standard.

Climate change – the broader set of changes that go along with warmer temperatures, including changes in weather patterns, the oceans, ice and snow and ecosystems around the world.

CO_2 – carbon dioxide.

Compact Florescent Light (CFL) – a type of light bulb that uses up to 75 per cent less energy than a traditional bulb.

Community garden – a single piece of land gardened collectively by a group of people.

Compost – organic matter that has been decomposed and is recycled as a fertilizer and soil amendment.

Compost tea – liquid fertilizer made by soaking or steeping compost in water.

Contaminants – chemicals and particles in the environment that have the potential to affect our health and the environment.

Consumer – a person who buys and uses up goods.

Conservation – the protection, preservation, management or restoration of wildlife and of natural resources such as forests, soil and water.

Corrosive – the gradual destruction of material, usually metals, by chemical reaction with its environment.

–D–

Dark sky – the night sky that is unaffected by polluting light.

Daylighting streams – exposing formerly culverted or buried streams.

DDT – dichlorodiphenyltrichloroethane, an insecticide that is toxic to animals and humans.

Debris – the remains of something that has been destroyed or broken up.

Decompose – to break down through chemical change.

Decomposition – breakdown or decay of organic materials.

Dehydrate – to remove water from (as foods).

Depleted stocks – in fishery context, the population is so low that it can't function or reproduce properly.

Divert – to cause (someone or something) to change course or turn from one direction to another.

Down-cycle – the process of converting waste materials or useless products into new materials or products of lesser quality and reduced functionality.

Drying – a method of food preservation that works by removing water from the food, which inhibits the growth of microorganisms.

Durable – able to last a long time.

–E–

Eco-friendly – a term used to describe a product or service that is more sensitive to the environment.

Eco-label – a seal or logo indicating that a product has met a set of environmental or social standards.

EcoLogo™ – North America's most widely recognized and respected certification of environmental leadership.

Ecological footprint – a measure of human demand on the Earth's ecosystems which is compared to the ability of the earth to supply those resources.

Economics – of, relating to, or based on the production, distribution and consumption of goods and services.

Economy – the system or range of economic activity in a country, region or community.

Ecosystem – a natural community of plants, animals and other living organisms and the physical environment in which they live and interact.

Efficient – capable of producing desired results especially without waste (time or energy).

Electrical grid – a network of poles and power lines that provide a path for electrical energy to flow across the country to users.

Effluent – outflow from a sewer or sewage system, or a discharge of liquid waste, as from a factory or nuclear plant.

Emissions – the release of a gas (such as carbon dioxide) or other substance into the air.

Emphysema – a condition marked by abnormal enlargement of the air spaces of the lungs, shortness of breath, and often by faulty heart action.

Energy audit – the process of inspecting a home, workplace or other building in order to find ways to use less energy.

Energy conservation – the act of using less energy or saving energy.

Energy consumption – the amount of energy used. Used to measure appliances and electronics to determine how energy efficient they are.

Energy efficiency – using energy in the most economical way and keeping its use to a minimum.

Energy efficient – a term that describes products and actions that use less energy due to advanced technology and equipment.

EnerGuide – the official Government of Canada mark associated with the labeling and rating of the energy consumption or energy efficiency of specific products.

ENERGY STAR® – an international standard used to identify the most energy efficient appliances and electronics.

Energy vampire – an appliance or device that uses electricity even when it is turned off.

Environmental awareness – an understanding of environmental issues which allows people and businesses to make choices that are better for the environment.

Environmental indicators – a sign or signal that is used to track changes to the quality and condition of the air, water, land and ecological systems.

Environmental restoration – the deliberate attempt to speed recovery of damaged areas.

Ethanol – a type of alcohol that can be produced from different forms of biomass, such as agricultural crops. Can be burned as a fuel, often by blending it with gasoline.

Eutrophication – the artificial enrichment of an aquatic system through the addition of nutrients, especially phosphates and nitrates.

Extinct – no longer existing.

–F–

Fertilizer – a substance (as manure or a chemical) used to make soil produce larger or more plant life.

Food preservation – the process of treating and handling food to stop or slow down food spoilage and allow for longer food storage.

Food miles – a term which refers to the distance food is transported from the time of its production until it reaches the consumer.

Formaldehyde – a colourless gas that consists of carbon, hydrogen and oxygen that has a sharp irritating odour. When dissolved in water, is used to disinfect or to prevent decay.

Fossil fuels – fuels such as coal, oil and natural gas that formed from the remains of ancient plants and animals buried underground.

Freezing – the withdrawal of heat to change something from a liquid to a solid.

Freshwater – of, relating to, or living in fresh water.

Fuel consumption – a term used to describe how much fuel a vehicle will use, expressed in litres per 100 kilometres (L/100 km) or miles per gallon (mpg).

Fuel economy/efficiency – a term used to describe how efficient vehicles are, or how little fuel is used, expressed in litres per 100 kilometres (L/100 km) or miles per gallon (mpg).

Fully exploited – in fishery context, the number of fish taken out equals the number being born.

Fungicides – any agent that destroys or prevents the growth of fungi.

–G–

Garbage – discarded or useless material.

Gas mileage – a term used to describe how much fuel is used by a vehicle, expressed in miles per gallon (mpg) or litres per 100 kilometres (L/100 km).

GDP – Gross Domestic Product.

Geothermal energy – heat, hot water or steam from within the Earth that is used to create electricity and for heating and cooling.

Genetically modified organism (GMO) – an organism whose genetic characteristics have been altered using the techniques of genetic engineering.

Gigawatts – a unit of electric power equal to one billion (10^9) watts.

Glare – when light shines intensely, blindingly and sometimes dangerously.

Global climate change – see Climate change.

Going green – the process of changing one's lifestyle for the safety and benefit of the environment.

Green – the term used to describe something that is friendly to the environment.

GNP – Gross National Product.

Greenie – a conservationist or environmentalist.

Green energy – electricity that has been produced using renewable resources, such as wind or solar and does not create greenhouse gasses.

Green materials – in composting, the nitrogen rich materials which are often green in colour.

Green products – unregulated term to describe products that are better for the environment.

Greenhouse gases – natural or manmade gases in the atmosphere that trap heat from escaping from Earth and contribute to the greenhouse effect. Include water vapour, carbon dioxide, methane, nitrous oxide, and fluorinated gases.

Greenwash – the provision of misleading information by an organization or company to conceal its abuse of the environment in order to present a positive public image, or to promote the perception or idea that a company is environmentally-friendly.

Greywater – wastewater from household baths and washing machines that is recycled especially for use in gardening or for flushing toilets.

Gross Domestic Product (GDP) – the total market value of all the goods and services produced within the borders of a nation during a specified period.

Ground water – water that occurs below the surface of the Earth, where it occupies spaces in soil or layers of rock.

Gyre – a huge slowly moving spiral of water.

–H–

Habitat – the place or environment necessary in order for plant and animal species to carry out their life cycle.

Halogen – any of the elements fluorine, chlorine, bromine, iodine and astatine. Used in a type of light bulb.

Herbicides – a chemical agent that destroys plants or inhibits their growth.

High-density polyethylene (**HDPE**) – #2 plastic. A dense, economical hydrocarbon-plastic, having good moisture barrier and chemical resistance but low gas barrier properties. Used commonly for bags, bottles and household products.

High-efficiency furnace – a heating device that returns to the heating environment more than 84 per cent of the heat it generates.

Hybrid – something of mixed origin or composition; in terms of vehicles, has a gasoline engine and an electric motor, each of which can propel it.

Hydrocarbons – a compound of hydrogen and carbon; the chief components of petroleum and natural gas.

Hydroelectric station – a power plant that uses the energy from moving water to produce electricity.

Hydroelectricity – electricity that is created using the flow of water.

Hydrogen sulfide – a flammable poisonous gas with a disagreeable odour suggestive of rotten eggs.

Hydrology – the study of the movement, distribution and quality of water on the landscape.

Hydropower – electricity created using energy that comes from moving water.

—I—

Idling – to run without being connected for doing useful work.

Industrialized – where the economic activity concerned with the processing of raw materials and manufacture of goods in factories.

Incandescent light bulb – the most common type of light bulb which produces light when electricity heats a thin metal wire.

Industrial Revolution – a period of social and technological change in the 18th century in which manufacturing began to rely on steam power, fueled primarily by coal, rather than on water or wind.

Inertia – a property of matter by which it remains at rest or in unchanging motion unless acted on by some external force.

Insecticides – chemicals used to kill insects.

Insulation – material that reduces or prevents the transmission of heat or sound or electricity.

International Organization for Standardization (ISO) – an international non-governmental organization that produces world-wide industrial and commercial standards.

Irrigation – to supply with water by artificial means.

ISO – International Organization for Standardization.

–J–

Joule (J) – a unit of energy; the energy expended in applying a force of one newton through a distance of one metre or in passing an electric current of one ampere through a resistance of one ohm for one second.

–K–

Kilojoule (kJ) – a unit of energy.

Kilopascal (kPa) – a measure of pressure.

Kilowatt-hour (kWh) – a unit for measuring the use of electricity.

Krill – small crustaceans and their larvae that make up plankton and form a major food of baleen whales.

–L–

Landfill – a system of trash and garbage disposal in which the waste is buried between layers of earth.

Lasagne garden – no-dig, no-till gardens that are created by layering organic materials. Also known a sheet composting.

Leachate – water that has percolated through a solid and leached out, or drained away, some of the constituents.

Lead – one of the heavy metals; bluish-gray, soft, malleable, and poisonous to animals. Used in roofing, plumbing, ammunition, storage batteries, radiation shields, etc.

Legislation – law enacted by a legislative body.

Light clutter – excessive groupings of lights.

Light Emitting Diode (LED) – a device that uses a material called a semi-conductor to produce light without using a lot of electricity.

Light trespass – **l**ight falling where it is not wanted or needed.

Low Density Polyethylene (LDPE) – # 4 plastic, widely used for manufacturing various containers, dispensing bottles, wash bottles, tubing, plastic bags for computer components and various molded laboratory equipment; most common use is in plastic bags.

Lumen – measure of brightness.

–M–

Materialism – a great or excessive regard for worldly concerns.

Megawatt hours (MWh) – a unit of energy, especially electrical energy, equal to the work done by one watt acting for one hour and equivalent to 3,600 joules.

Methane – a colourless, odourless greenhouse gas, produced by the decay of plants, animals and waste.

Methyl chloride – a nonflammable poisonous liquid used as a solvent, paint remover and refrigerant.

Microclimate – the climate of a very small or restricted area.

Microorganisms – organisms that are so small that they are invisible to the naked eye.

Moratorium – suspension of an ongoing activity.

Mulch – a protective covering spread to protect the roots of plants from heat, cold or evaporation, prevent soil loss, control weeds or enrich the soil.

–N–

Natural resources – substances such as oil, fish, trees and water that are found in the natural world and are valuable to humans.

Nitrogen dioxide (NO2) – a highly poisonous brown gas, often found in smog and automobile exhaust fumes. Used as a nitrating agent, a catalyst and an oxidizing agent.

Nitrous oxide (NOx) – a colourless, odourless greenhouse gas that occurs naturally and is produced in combustion and other activities.

Non-renewable resource – a natural resource that cannot be produced, replaced, regrown or reused once it has been used, such as fossil fuels coal, oil and natural gas.

Nutrient – any substance that can be metabolized by an organism to give energy and build tissue.

–O–

Ocean gyre – circular ocean current.

Ocean pollution – the contamination of ocean water by harmful chemicals which are discharged into these ocean bodies as a result of human or natural activities.

Off-gassing – the release of chemicals into the air through evaporation.

Organic compounds – any of a large class of chemical compounds whose molecules contain carbon.

Organic farming/food – relating to, producing, dealing in, or involving foods produced with the use of feed or fertilizer obtained from plants or animals and without the use of laboratory-made fertilizers, growth substances, antibiotics or pesticides.

Organic waste – waste that can be broken down by other organisms, like worms.

Overfished – to fish a body of water so extensively as to exhaust the supply of fish by taking more fish than are being produced.

Over-illumination – the presence of lighting intensity beyond that required for a specified activity.

Ozone (O_3) – a gas made up of three atoms of oxygen bonded together; high in the atmosphere, shields the Earth from harmful ultraviolet radiation that comes from the sun; closer to the Earth's surface. Is a pollutant that is formed by other pollutants that react with each other.

Ozone depletion – destruction of the upper atmospheric layer of ozone gas.

–P–

Particulate matter (PM) – a small discrete mass of solid or liquid matter that remains individually dispersed in gas or liquid emissions; usually considered to be an atmospheric pollutant.

Peak oil – the point in time when the global production of oil will reach its maximum rate, after which production will gradually decline.

Per capita – by, or for, each person.

Perchloroethylene – a colourless, nonflammable organic solvent used in dry-cleaning solutions and as an industrial solvent.

Persistent organic pollutants (POPs) – toxins resulting from a manufacturing process, which remains in the environment for many years

Pesticide – a chemical used to control, repel, attract or kill pests, such as insects, weeds or microbes.

Pesticide drift – the physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site.

Pesticide resistance – the adaptation of pest species targeted by a pesticide resulting in decreased susceptibility to that chemical.

Petajoule (pJ) – a unit of energy.

Petroleum – an oily flammable liquid that may vary from almost colourless to black, obtained from wells drilled in the ground, and is the source of gasoline, kerosene, fuel oils and other products.

Photodegrades – breaks down in light.

Photosynthesis – the process by which green plants use sunlight, water and carbon dioxide to make food and other substances that they use to grow.

Photovoltaic – a technology in which a device or solar panel converts energy from sunlight into electricity.

Pickling – vegetables (especially cucumbers) preserved in brine or vinegar.

Planned obsolescence – the process of becoming obsolete; falling into disuse or becoming out of date.

Plankton – the aggregate of small plant and animal organisms that float or drift in great numbers in fresh or salt water.

Pollution – the act of contaminating or polluting, especially the contamination of soil, water or the atmosphere by the discharge of harmful substances.

Pollutants – a substance or condition that contaminates air, water or soil.

Polychlorinated biphenyls (PCB) – a group of organic compounds used in the manufacture of plastics, as lubricants, and dielectric fluids in transformers, in protective coating for wood, metal and concrete, and in adhesives, wire coating; are highly toxic to aquatic life and persist in the environment for long periods of time.

Polycyclic aromatic hydrocarbons (PAH) – a group of organic contaminants that form from the incomplete combustion of hydrocarbons, such as coal and gasoline; toxic to aquatic life and suspected human carcinogens.

Polyethylene teraphthalate (PET) – #1 plastic; high gloss, crack-resistant transparent plastic used largely in making carbonated beverage bottles.

Preservative – a chemical compound that is added to protect against decay or decomposition.

Psi – measure of pressure, pounds per square inch.

–R–

Radioactive – Emitting or relating to the emission of ionizing radiation or particles.

Radon – a heavy radioactive gaseous element formed by the breaking apart of radium atoms.

Ramsar sites – wetlands designated as Wetlands of International Importance under the Convention on Wetlands held at Ramsar, Iran in 1971.

Recycling – the process of collecting and converting materials that are no longer needed into new products.

Reduce – to become smaller or less in size or amount; in waste management, to decrease all unnecessary waste in every way possible.

Refuge – a place that provides shelter or protection.

Re-gift – to give someone a gift that was previously received from someone else.

Renewable energy – energy or electricity that are continuously or easily replenished naturally, such as the sun, wind and water; considered clean sources as they do not consume any resources or create greenhouse gas emissions.

Renewable resources – natural resources that continually regenerate such as wind power, solar or hydro.

Repurpose – use something for a purpose other than its originally intended used.

Respiratory – the system for taking in oxygen and giving off carbon dioxide; in terrestrial animals this is accomplished by breathing.

Restoration – the act of bringing back to or putting back into an earlier or original state.

Reuse – using a product more than once for its original purpose or for a new purpose rather than throwing it away.

Rolling resistance – the force that opposes motion as a tire or other rolling object rolls over the ground.

RSI value – Resistance Système International (metric terms) to indicate a precise measurement of the insulation's resistance, or thermal resistance value, to heat flow.

Run-off – the draining away of water from the surface of an area of land, a building or structure, etc.

R value – imperial measurements to indicate a precise measurement of the insulation's resistance, or thermal resistance value, to heat flow.

–S–

Sanitation – the promotion of community hygiene and disease prevention especially keeping up sewage systems, collecting and disposing of trash and garbage, and cleaning streets.

Selective breeding – the process of breeding plants and animals for particular genetic traits.

Sheet composting –lasagne gardening.

Sky glow – a type of light pollution; illumination of the night sky in urban areas.

Sleuth – a detective.

Slow Food –a social movement founded to counteract fast food and fast life, the disappearance of local food traditions and how our food choices affect the rest of the world.

Smart appliances – appliances that optimize energy use by operating at low periods.

Smart meters – an Internet-capable device that measures energy, water or natural gas consumption of a building or home.

Smelter – an industrial plant for smelting, or melting ore usually in order to separate the metal.

Smog – air pollution caused by chemical reactions of various pollutants emitted from different sources.

Soaker hose – weeper hose, a hose made of a porous material that allows water to seep out along the length of the hose.

Solar energy – energy that is created from sunshine; can be used to either generate solar power or to heat water or buildings.

Solar hot water – a term used to describe water that was heated by a solar water heater.

Solar water heater – a system used to harness the energy from the sun to heat water; typically made up of a solar collector panel, a circulating pump, and a hot water storage tank.

Solar energy – energy that comes from the sun's rays that reach the Earth.

Solar panel – a device that can convert energy from the sun into either electricity or to heat water.

Source reduction – decrease waste at source.

Standby power – electrical power used by appliances and equipment while switched off or not performing their primary function, often waiting to be activated by a remote control; power draw of an appliance in its lowest power mode.

Strategic – of great importance within a whole or for a planned purpose.

Sulphate – a compound, especially a salt, formed by the reaction of sulfuric acid with another substance.

Sulfur dioxide – a heavy strong-smelling gas that is used especially in making sulfuric acid, bleaching, preserving things and as a refrigerant; is a major substance in air pollution especially in industrial areas.

Surface water – water on and above the surface of the earth.

Sustainable development – development that is capable of being continued with minimal long-term effect on the environment.

Sustainability – defined by the Brundtland Commission as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sweet spot – refers to almost anything that embodies an optimum combination of characteristics and qualities; is most efficient, useful or popular.

Synergy – greater than the sum of its parts.

–T–

Terrestrial – of, or relating to, land as distinct from air or water; living on, in, or growing from land.

Third-party audit – an independent verification of the claims being made.

Tidal power – a form of renewable energy generated from the natural rise and fall of the ocean.

Tonnes of oil equivalent – represents energy generated by burning one metric tonne of oil.

Toluene – a colourless flammable liquid obtained from petroleum or coal tar; used as a solvent for gums and lacquers and in high-octane fuels.

Toxin – a substance that causes damage to biological systems by chemical means; life-threatening in small quantities.

Traceability – refers the ability to describe and follow the life of a product.

Tundra – a treeless plain especially of arctic regions, having a permanently frozen layer below the surface soil and, plant life made up mostly of mosses, lichens, herbs and very small shrubs.

–U–

UNESCO – United Nations Educational, Scientific, and Cultural Organization, established in 1945 by the United Nations to promote the exchange of information, ideas, and culture.

Up-cycle – the process of converting waste materials or useless products into new materials or products of better quality or for better environmental value.

Uranium – a silvery heavy radioactive metallic element.

–V–

Ventilation – circulation of air; a system or means of providing fresh air.

Vermiculture – the practice of feeding organic waste to earthworms to decompose it through digestion, a form of composting by the use of worms.

Visibility – the degree of clearness of the atmosphere; ability to see.

Volatile Organic Compounds (VOCs) – organic chemicals that evaporate readily and exist as gases in the air; can affect the environment and human health.

–W–

Waste – material left over, rejected or thrown away; an unwanted product obtained in the course of a manufacturing or chemical process.

Water vapour – water that is present in the atmosphere as a gas.

Watt – a measurement of power, or the rate at which energy is used; usually used when talking about electricity.

Weather – the condition of the atmosphere at a particular place and time.

Wetland – an area of land that is periodically saturated with water, which influences the types of plants and animals that can live there. Includes swamps, marshes, bogs and other similar areas.

Weather strip – a strip of material used to seal a door or window around the edges.

Wetlands of International Significance – wetlands designated according to the criteria set out in the Convention on Wetlands held at Ramsar, Iran in 1971.

Wind energy – energy that comes from the power of moving air; electricity that is created using a wind turbine.

Wind farms – a group of wind turbines that are located together.

Wind turbine – a machine that uses the force of the wind to generate electricity.

Wind resistance – the opposition of the atmosphere to forward movement.

World Heritage Site – a natural or man-made site, area, or structure recognized as being of outstanding international importance and therefore as deserving special protection; designed under UNESCO's the World Heritage Convention.

Worm castings – digested and excreted food products from worms.

Worm tea – the liquid produced during vermiculture; also known as worm juice or worm wee.

–X–

Xeriscaping – landscaping and gardening in ways that reduce or eliminate the need for supplemental water from irrigation.

Xylene – a colourless flammable volatile liquid hydrocarbon used as a solvent.

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