

WASTE OVERVIEW



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Waste Overview

Our planet can no longer support the present consumption habits and environmental damage brought about by its five billion people. In a mad rush for progress, we have helped change productive land into desert, produced acid rain, dangerously increased the Earth's temperature, depleted the ozone layer, contaminated food chains and water supplies with chemicals, and filled the land with piles of garbage.

The time has come for each person to do his or her part to help rectify these problems. Most people will ask how can one person help to fix an entire planet. The answer is to fix your own little piece of it. Small changes by many people add up to big changes. One of the best ways to help is by being less wasteful.

Waste
is the discarded or unwanted by-products
of human activities.
It can be biodegradable or non-biodegradable and occur in
any of the three physical states: solid, liquid, or gaseous.

Waste uses energy, renewable and non-renewable resources, land and money. It creates pollution and pollution related problems (e.g., global warming). Industrialized nations and countries with high standards of living are the biggest waste producers. Canadians are number one in the world; each person makes, on average, one tonne per year.

The time has come for each of us to look at the waste we generate. Through careful re-evaluation of our actions and buying habits, we can improve our homes. If enough people participate, an entire community could be changed. Enough communities would improve a country and enough countries, the planet itself. There is only one Earth.

Many intricate pieces make up this planet. We must clean or repair the piece each of us has changed. Being the best "wasters" is not a title or position to be proud of.



History of Waste (cont.)

ings and quarries. The cities created new job opportunities, causing an increase in urban population, which resulted in other problems. Waste, including human excrement, flowed untreated through open sewers into lakes and rivers. Mounds of garbage were left in the streets next to dead animals. All the people, all the factories and all the pollutants added up to a major health hazard. Efforts were made to better living conditions but this had little effect on the waste produced. Industry continued to progress into the twentieth century.

By the time Mr. Henry Ford initiated the first assembly line, industry was a fixture in North American and European countries. While waste removal became more organized, disposal methods remained the same, and little thought was given to the resulting consequences.



Despite the hardships of the first half of the 1900's, the years after the Second World War brought economic prosperity to the victorious nations and eventually to those defeated. In North America thousands of new homes were built for returning servicemen and women. Every home was to have a car. Massive highways were constructed. Television and radio brought the latest and greatest goods into people's living rooms. Science brought ever increasing advances in farming, medicine and the production of chemicals.

WASTE OVERVIEW - BACKGROUND INFORMATION

History of Waste (cont.)

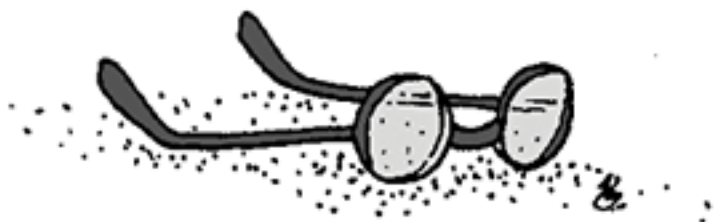
The healthy economy and the increased population, meant more people could afford more goods. This was the birth place of today's throw-away society. People were taught that it was beneficial for the country to buy more and more items. We were also led to believe that newer was always better. Manufacturers made products with planned obsolescence; items were engineered to be useful for only a certain time. This led to the ultimate in throw-away products, disposable goods. Today, for every dollar spent on disposables, the taxpayer spends 8% more to get rid of them. This does not take into account the environmental costs.

With disposable goods came a disposable attitude which helped cause the present waste problem. We used and discarded material without any thought as to what might happen. Waste was left in woodlots at the back of farms, thrown out of car windows, burned and dumped in poorly located landfills.

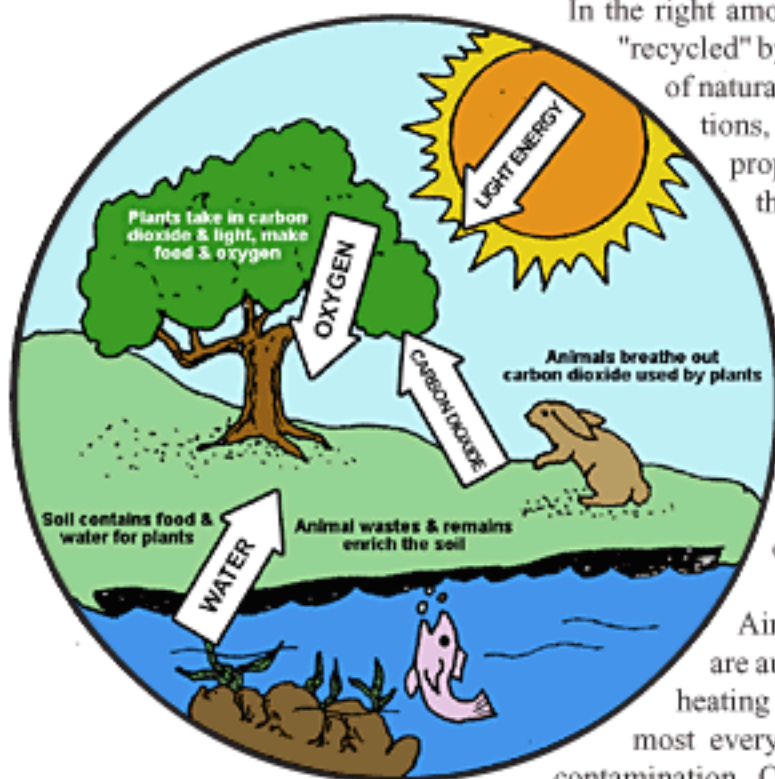
We continued the high rate of consumption through the "Hippie" generation of the sixties, and into the seventies, where even an oil crisis and disco barely slowed us down. After a recession in the early eighties, consumption reached new heights, when the "Yuppies" appeared. These people lived a fast paced life where there was never enough time; speed and convenience became essential to their lifestyle. Status was measured by the kinds and amount of goods one accumulated. In a push to climb the social ladder they continuously bought or charged the latest and most expensive products. Thankfully, this age also saw an increase in public awareness. People had begun to question and examine the damage caused by their habits.

The oil crisis highlighted the fact that the world's resources were not unlimited. The Earth needed attention if it was to continue to support all forms of life. The results can be seen today as people, communities and entire countries are making attempts to help clean up the planet. One method is through the better handling of waste.

Proper *reduction, reuse, recycling, composting, recovery* and disposal methods will help the Earth recover from the waste it has been force fed. Hopefully we will learn from the mistakes our ancestors made, to ensure history will not repeat itself.



Pollution



In the right amounts and under the right conditions waste is "recycled" by the Earth. When the quantity or composition of natural and synthetic materials exceeds these limitations, air, water and soil pollution are created. Improper waste management contributes directly to this creation.

We will examine some typical examples of how pollution is made and the effects this has on the environment. It is important to remember that one type of pollution (air, water, soil) can generate one or more of the other types. A person should also realize a particular pollutant can contribute to several different examples of pollution.

Air pollution is world famous. The main sources are automobiles, power plants, industry, residential heating and the improper incineration of waste. Almost everyone has heard of at least one form of this contamination. One of the household names, in this area, is the Greenhouse Effect.

The sun is the Earth's most important source of energy. Much of the energy arrives as visible light (short-wave radiation). The light is absorbed by the planet, which in turn emits infra-red (long-wave) radiation back out towards space. Carbon dioxide (CO_2) naturally present in the atmosphere absorbs the long-wave radiation, or reflects it back towards the Earth's surface. This process is beneficial in helping to heat our planet. Because the CO_2 works like the glass of a greenhouse, this phenomenon is called the Greenhouse Effect.

However, the amount of fossil fuels and wood we have burned has increased the carbon dioxide to dangerous levels. Along with methane, chlorofluorocarbons, tropospheric ozone and nitrous oxide, CO_2 is keeping too much longwave radiation in the atmosphere. The result is Global Warming, which can cause melting of polar icecaps and thereby the flooding of coastal areas, changes in climatic regions and patterns plus the loss of valuable agricultural land. It is estimated that the global temperature could rise 3°C . In a period spanning half a human generation, the globe would experience an overall warming greater than has occurred throughout the history of humanity.

The depletion of the ozone layer is another problem associated with polluted air. In this case we are referring to the beneficial ozone located in the stratosphere, not harmful tropospheric ozone. Approximately 99% of ultraviolet rays are screened out by stratospheric ozone.

Pollution (cont.)

Chlorofluorocarbons (CFCs) are synthetic chemicals used as propellants in aerosols, as coolants in refrigerators and air conditioners and in the making of some plastic foam. CFCs float up into the stratosphere where they begin to destroy the ozone layer. Even though this layer is broken down and replaced by a natural process, air pollution accelerates the breakdown; ozone is being taken away faster than it is being replaced and radiation reaches the Earth. As a result, serious health problems including skin cancer and eye disease can occur. Even though CFCs are being phased out in Canada, their continued production and disposal still pose a problem. The chemicals are stable, meaning they will not break down for hundreds of years!

Every living organism on Earth needs water to survive, especially plants and animals. Fouling our water can lead to serious trouble. In industrial countries lakes and rivers are "dying" due to acid rain. Sulphur dioxide gas (SO₂) and nitrogen oxides are released when coal or oil is combusted. These pollutants escape from the chimneys of some power stations and the exhausts of some automobiles. Close to 50% of these emissions fall back to earth as dust and particulate matter, within 30 kilometres of their source. The other half mixes with water in clouds to form acid rain, and acid snow, sleet or mist. Some of this precipitation falls locally, however under the right conditions wind currents can carry the pollution great distances. It is believed that some of the acid rain in Europe originated in the United States.

Not only are bodies of water contaminated but vegetation is destroyed, soils are polluted and buildings eroded when acid precipitation falls. It should be noted that the term acid means the degree of acidity in relation to "natural" rainfall; natural rain has a range from pH 5.0 to pH 5.6 while acid rain rates from pH 4.0 to pH 4.7 (battery acid is at pH 1.0).

Accidental or deliberate discharges of waste into water can render it useless. Only 1% of the water in the Great Lakes flows out of the drainage basin, every year. Whatever is put into the lakes, stays there. Urban and agricultural runoff washes street dirt and farm fertilizers into sewers and tiles. At some beaches biomedical refuse, including used syringes, has washed ashore. Hazardous and nuclear waste was and still is deliberately thrown overboard to rest at the bottom of the oceans. Landfills that are not lined, monitored and well managed can allow rain to percolate through waste. The moisture picks up pollutants, carries them down into the soil and into groundwater. Clean, fresh water is in short supply in places across the world. Disease and death can lurk in bad water. Because water is even more essential than food, water pollution needs to be eliminated.

Fertilizers and pesticides are the product of great scientific endeavours. They help grow better crops with

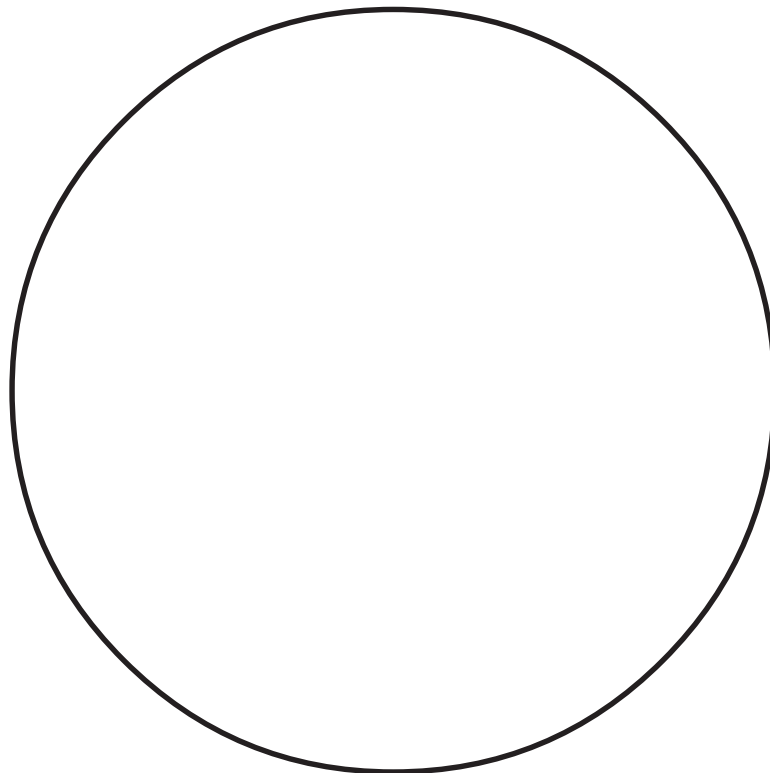
WASTE OVERVIEW - BACKGROUND INFORMATION

Pollution (cont.)

high yields and greener lawns with fewer weeds. However, these products also create soil pollution. The composition of the dirt is altered resulting in the natural nutrient level decreasing. The land becomes more dependent on the additives that further lowers nutrients and a never ending cycle develops.

Landfills and dumps badly affect the Earth's soils. The practice of burying garbage not only pollutes soil but takes valuable land out of production and use for decades.

Pollution is a very intricate problem. One source or type of contamination can produce many others. The examples we have just discussed are only a few of many. If a cure for one pollution can be found associated problems could also be rectified, until pollution is reduced to a manageable and sustainable level.



World Waste Management

Waste management differs from country to country, province to province and town to town. A complete list of every method could fill a set of encyclopedias. Instead of trying to explain each approach, we will look at common trends and unique examples throughout the world.

Developing countries are trying to implement official waste management policies and practices, especially in the area of recycling. However, the most effective methods may already be in use.

Poorer people have little waste to start; material is reduced, reused and recycled to the fullest out of economic necessity. In India, entire villages survive on landfills. People build homes and furniture, make clothes, get fuel, generate income and even find food from wealthier citizens' trash. Entrepreneurs from the slums of Rio De Janeiro turn old bottles into glasses and vases. People in the Philippines give recyclables to men who shout from the street. These "announced collectors", as they are called, work for dealers who sell the material for profit. Not only does this home grown waste management reduce waste, it creates an informal economy (creating jobs). Unfortunately, child labour is sometimes used; these children are sometimes abused and mistreated.

With the fall of the Iron Curtain, we were allowed to see the effects communism (socialism) had on many nations. We have all heard of the economic dilemma these people faced, but what about their waste? In Poland, landfilling was the main waste disposal technique. A few truck loads of garbage would be dumped at the first suitable location. Government officials would see this "dump" on a map and legalize it. There was generally no site inspection, no samples taken, nothing. Of the country's 681 landfills, 50% did not meet Polish environmental requirements. Landfills had no liners and no leachate or methane collection/control systems. Waste was not separated nor was hazardous waste controlled.

Today some cities are trying recycling and other separation methods on a small scale. The tough economic climate has slowed the purchase and implementation of modern waste management technology and techniques. Poland and its sister countries of the old Eastern Bloc have seen some help arrive as western European companies begin to tap into these newly liberated waste markets.

However, western Europe is not without its own problems. Space for the disposal of waste is limited. In order to combat this situation, incineration is used. For years, garbage has been reduced to ash and smoke. Recent research and development have created cleaner burning facilities that produce energy for heating and



World Waste Management (cont.)

lighting. Europe has also begun to recognize the need for alternatives to incineration. Recycling programs are springing up over the entire continent. Depots are located at strategic points within cities; curbside collection is not in widespread use due to the narrow streets and high densities of most urban areas.

Denmark has an extensive waste management program. To produce energy, seventy percent of domestic waste is incinerated. Programs to find alternatives to incineration are presently underway. Commercialized **anaerobic digestive plants** convert organic waste into a gas, called biogas, and a type of natural fertilizer. The gas is used to produce energy while the residual matter (fertilizer) is distributed back to the agricultural land (and the *ecosystems*) from which the organic waste originated. Danes also have a national industrial hazardous waste collection program. Pharmacies allow citizens to dispose of old medicines. Beer and soft drinks must be sold in returnable containers. The promise of a "super country", the united European Community, will likely lead to improved waste and environmental legislation.

Japan is synonymous with industry. A large percentage of the world's cars, TVs, VCRs, stereos and other goods come from the land of the rising sun. Like Europe, Japan has used incineration to save space and reduce its waste. Since the mid 1970's a shift towards recycling and reuse has taken place. Approximately 90% of local communities practice source separation. Waste is separated to recover combustible materials or recyclables, depending upon the local waste management practices. New legislation is being developed to change the focus of these practices from post-consumption to pre-consumption concern. Industry has been slow to reduce waste in the design and manufacturing stages, but change is occurring. It is interesting to note that recyclables are not considered waste; the Japanese call them valuables.

One of the most horrific aspects of global waste handling is foreign dumping. Organizations sell banned products and hazardous waste to middlemen. These men in turn sell the products to nations hungry for foreign business. In some cases a country has bought chemicals, thought to be useful, only to get a load of improperly packaged hazardous waste. The need for hard currency has resulted in countries knowingly and unknowingly becoming "dumps" for the First World.

Only through the careful identification of every nation's waste problems can a wide scale improvement be achieved. The first step would be to share economic and technological prosperity so waste management can be executed, more appropriately, on a global scale.

Canada's Provincial Policies

Rather than sift through pages and pages of information, the provincial and territorial waste policies and information has been incorporated into a chart (A11).

Facts and figures were obtained from each environment ministry or the appropriate branch of a ministry. When examining the information keep in mind that the figures are not 100% accurate but were the most precise data available at the time of publishing. Most waste data is based on estimates and the figures change almost daily. The recording of waste is only a relatively recent practice.

Included with the numbers is information about legislation, public education programs and special problems a province or territory has in the field of waste.

Did you know...
Canadians produce
30 million tonnes
of garbage per
year, making us the
**#1 waste producer
in the world.**
This is not an
enviable position
to be in.



Ontario Waste Breakdown

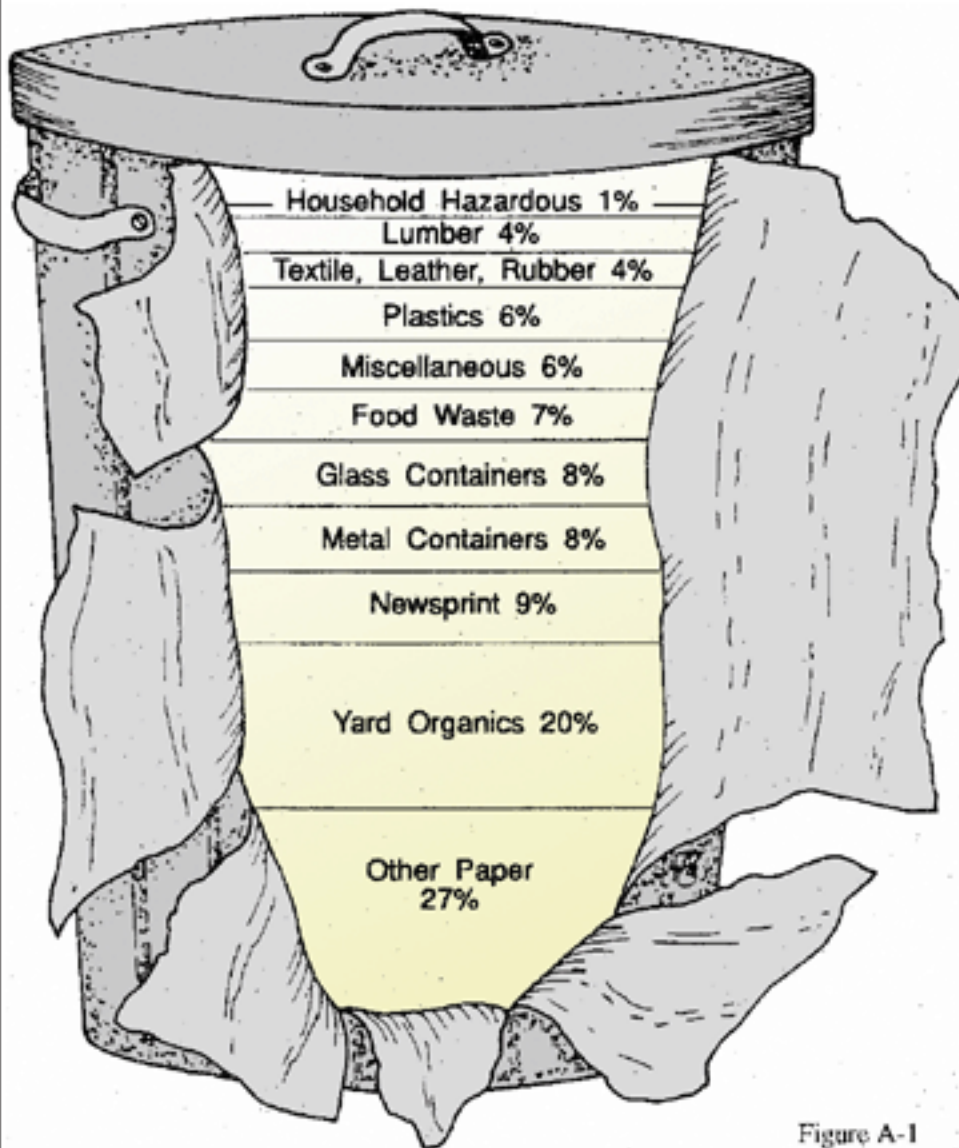


Figure A-1

Ontario generates close to 10 million tonnes of waste every year; this works out to be one tonne for each person in the province. Industrial/commercial/institutional (I.C.I.) sources produce 60% of our garbage. Hospitals, schools, offices, manufacturing facilities, restaurants and retail outlets are examples of I.C.I. waste producers.

The remaining waste, 4 million tonnes, is made in and around our homes. On average, each individual throws out one kilogram of household waste daily. The contents of a typical garbage can are shown in Figure A-1.

All the figures mentioned above are from the Ontario Ministry of the Environment and Energy and were the most recent available. Waste data is based on estimates that are affected by fluctuations in the economy, illegal burning, out of province

processing and disposal along with other uncontrollable factors. Even waste in some Ontario landfills is not properly tallied. Despite these variables, the statistics we have used are as accurate as possible.

Nearly one third of the country lives in Ontario. Most of these people are found in the southern portion of the province. Crammed in with all these people is a great deal of industry. Add in the fact that some of the country's most productive farmland is found in the Ottawa to Windsor corridor, and one can see space is at a premium.

The 10 million tonnes of waste we create has to fit in somewhere. Present landfills are quickly nearing the limit of their capacity. New landfills are becoming harder to locate and are meeting growing public opposition by neighbours of proposed sites. Waste incinerators have come under increased government restrictions, are perceived as hazards to the public and still do not eliminate all the waste. One of the solutions to our provincial problem is to follow the *waste management hierarchy* as outlined on pages A16 and A17.

Waste and Our Government

In Canada, waste management is administered under the general category of the environment. Federal, provincial and municipal governments each play a different, but equally important part in controlling Canada's waste and protecting our environment.

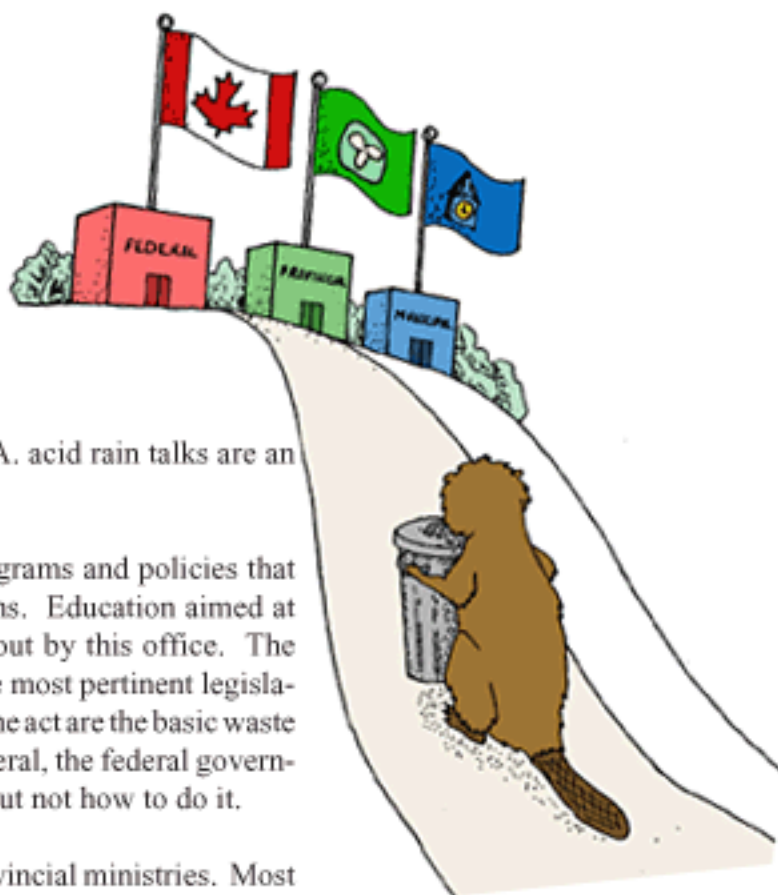
Environment Canada is the federal bureau responsible for the nation's domestic and foreign environmental affairs. Internationally, the ministry enters into agreements and negotiations with other nations. The Canada-U.S.A. acid rain talks are an example.

At home, the agency produces legislation programs and policies that serve as guidelines for all political jurisdictions. Education aimed at heightening public awareness is also carried out by this office. The Canadian Environmental Protection Act¹ is the most pertinent legislation, produced at the federal level. Included in the act are the basic waste management parameters for the nation. In general, the federal government tells the provinces what has to be done but not how to do it.

Following the national government are the provincial ministries. Most provinces and territories have a ministry set up to look after the environment. In some cases, an office oversees the environment and other related areas.

For the province of Ontario, waste management is regulated by the Ministry of the Environment and Energy (M.O.E.E.). The licensing of recycling and disposal operators, waste generators, sanitary and secured landfills, pesticide retailers and users, along with other environmentally related practices and professions, is handled by the M.O.E.E. The Ministry is also responsible for assessing the environmental impacts new landfills, incinerators, even road and subdivisions might cause.

The Environmental Protection Act of Ontario² is written to meet needs that are special to this province, for example, dealing with our high percentage of industrial waste. Other important legislation that is related to waste management is as follows: Ontario Water Resources Act³, The Pesticides Act⁴, Regulation 346⁵ and Regulation 347⁶ and The Environmental Assessment Act⁷. Our environment ministry enforces the rules and regulations of both the federal and provincial acts. Hearings, public education and funding of special projects comes from this office. The M.O.E.E. establishes goals for waste reduction in Ontario and similar targets. Provincial ministries act, educate, mediate and legislate more concretely and productively than the federal government.



Waste and Our Government (cont.)

The third and final government involved in waste management is municipalities. The actual collection, diversion and disposal of waste is carried out by cities, towns, villages, townships, counties and regional municipalities. At minimum, these agencies must provide a sanitary landfill for their populace. The collecting and budgeting of funds for whatever waste management method or methods used is also a municipal function.

Local bylaws are passed by municipal councils to take into account special circumstances. Municipalities take the other governments' ideas and actions, fine tune them, then put them into practical applications.

The government responsibility with regard to waste management is structured much like a professional hockey team. Our federal government is the team owner. It decides what the long term goals are, how much money to spend in reaching these goals and the basic agenda to be followed.

A provincial government represents the general manager. It sets and enforces rules that will not only help to meet the owner's goals but also achieve goals it has set. Adjustments are made as the targets are reached or changed. Helping the coaches and players do a good job and ensuring they do it is the biggest part of the general manager's position.

Municipalities are the coaches. They teach and help the players to be successful. Good coaches bring out the best in the players. Goals are achieved, bad situations overcome and a sense of accomplishment is felt. Enthusiastic coaches create enthusiastic players. But who are the players?

The people of Canada are. By working together and doing our individual parts, we can "win a few." Enough wins can take us from being the biggest waste producer (last place) to a spot near the top of the standings.



Waste Management Hierarchy

So, you have decided to help the waste problem by better managing your own garbage. Now comes the hard part, when do you start, where do you begin, and what do you do?

Start right away, today, but start small. A good example would be to concentrate on changing the waste generated in your kitchen. By beginning small, a person is not overwhelmed and will develop useful habits more readily.

The question of what to do is not all that difficult to answer. By following the steps of the waste management hierarchy (see Figure A-2) all the garbage and leftovers, person, business, industry or other waste producer makes, will be better handled. A hierarchy is an arrangement based on an ascending or descending order; it is similar to ranking a group by order of preference.

The best method of managing waste is to reduce it. This is the first step in the hierarchy and is also the most effective. Reduction is the process of decreasing the amount of waste generated at each step of a product or material's development or use. This includes diminishing hazards by replacing a substance with a safer one. We are able to save energy, resources and space by producing less waste. Reduction goes right to the heart of the matter by slowing or stopping the production of trash before it enters the waste stream.



Figure A-2

Waste Management Hierarchy (cont.)

Reuse refers to finding another use for something that has already served its original purpose, without the need for remanufacturing or processing. Donating furniture and clothes to charitable organizations is one example. Using old ice cream tubs and margarine containers to store and freeze food is another. If you cannot reduce the need for a specific item, at least try to reuse it.

The third part of the waste management hierarchy is recycle; together, reduce, reuse and recycle form the famous "3Rs". Using a *Blue Box* or another form of recycling obviously keeps waste out of dumps and *landfills*. More importantly, it slows the need for virgin resources; many non-renewable resources are already in short supply. Remanufacturing aluminium from recycled goods is 95% more energy efficient than making it from raw materials. Mining waste is reduced by 97% when scrap iron is used instead of iron ore.

Recover is the often forgotten fourth "R". This procedure involves the extraction of organic materials or energy from mixed waste. Composting is one form of recovery. Kitchen waste, such as vegetable peelings, and yard waste, such as grass clippings, are decomposed into an organic matter that is used as a soil conditioner. Individuals and communities alike can compost. This process returns material back to a variety of ecosystems, rather than just those near the landfill.

Incineration can be used to recover energy from burning waste. Some facilities combust the waste to produce steam. The steam is used to produce electricity for heating and lighting. Incineration reduces the volume of waste that needs to be disposed. Unfortunately, burning waste may create air pollution; the ashes that are left after burning can also be hazardous (high levels of heavy metals and toxic substances).

The final and least desirable stage of the hierarchy is disposal. Landfilling is the primary method, but all forms of disposal are merely ways to avoid the real issue. A good analogy is the sweeping of dust under a rug. The waste is out of sight, but it hasn't really gone anywhere. Some waste will always have to be disposed, but there is no need to "throw away" as much as we do.

Geographic, economic, social and political factors can make one or more of the steps impractical. Placing deposits on glass juice bottles, so they can be reused, is unprofitable. Because the volume of bottles bought is low, in comparison to pop bottles, it is more practical and economical to recycle the juice containers. Another example is incineration. In the province of Ontario, political legislation and public pressure have restricted the use of this recovery method.

The hierarchy is by no means the final answer to the waste issue. It is, however, an excellent and extremely effective place from which to start.

Brewster Facts

1. The Earth is sick. The Earth needs our help.



2. We all need to help Clean up the Earth.

3. Three ways to help are Reduce, Reuse and Recycle. These are called the "3R's".



Garbage Overflow

OBJECTIVE: To illustrate what garbage is and how it can be handled. Children will learn the 3 R's of waste management; reduce, reuse, recycle. Printing, counting and vocabulary skills will also be enhanced.

MATERIALS: a week's worth of classroom garbage, easel, chalkboard, empty cardboard box, Blue Box (recycling container), empty garbage can, HANDOUT: The 3 R's (A23)

VOCABULARY: garbage, reduce, reuse, recycle

BACKGROUND:

On average, each year in Canada 30 million tonnes of waste is produced. Canadians generate more garbage per capita than any other country. Waste diminishes our natural resources and energy supplies. Improper treatment of waste can cause pollution and other environmental problems. Landfill space to hold the waste we throw away is difficult to find, costly to operate and takes productive land out of service for years. Reducing, reusing and recycling waste conserves resources and energy while diminishing environmental damage. Reducing means to simply make less waste. Avoiding excess packaging is one way to reduce. Reusing involves using an item for a purpose other than originally intended. Collecting egg cartons, styrofoam trays and catalogues for use in crafts is an example of reuse. Recycling is the collection and separation of waste for use as a raw material in re-manufacturing processes. Paper along with metals, plastics and glass containers can be recycled. Reduce, reuse, recycle are called "the 3 R's".

PROCEDURE:

While the procedure has been laid out over two days there is no reason why this activity could not be completed in one day; the time table given is merely a suggestion.

1. Ask the custodial staff to not empty the trash cans in the classroom for about a week before you start this activity. Let the garbage accumulate until it is overflowing (you may want to remove any food or potential hazardous materials from the garbage).
2. **Day 1** Ignore the garbage until one of the students mentions it, then draw everyone's attention to the garbage. Ask them what is in the can. Ask them what is garbage. Write their comments down on an easel or the chalkboard. Ask if they know any other names for garbage. Write these down also.
3. **Day 2** After the first day re-arrange the room so it is disorganized and messy. You may want to spread the garbage over the desks and around the room. Place a container marked "reuse", a separate container marked "recycle" (if the classroom has a Blue Box it will do) and an empty garbage can labelled "waste" in the room. When the children arrive ask them to describe how the room looks (messy, dirty, untidy). Mention how difficult it is to move around or find items in such a mess. Ask them what could be done to the items instead of throwing them away. Introduce the ideas of reduce, reuse and recycle. Ask the

Garbage Overflow (cont.)

PROCEDURE (cont.)

children what do these three words have in common (the letter R). Ask them to count the R's. Tell them that the 3 R's are good for the Earth because the R's keep the ground, the air and the water clean. Explain to the children that they will now practice the 3 R's by tidying up the room. They should put recyclable items in the recycle container, reusable objects in the reuse container and left over items in the garbage can. After the room is back in order distribute the HANDOUT: **The 3 R's** (A23). Have the students complete the HANDOUT by tracing the dotted R, colouring the second R then drawing their own R.

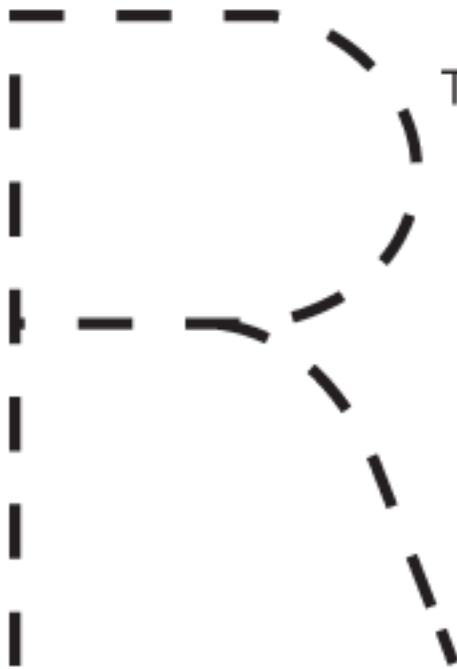
EXTENSION:

1. Have the children paint a picture. One half of the picture should show what the Earth/outside would look like if everyone just threw their garbage away (messy, dirty). The other half should depict a world with a Blue Box, sun, birds, trees, etc. where things are neat and tidy.
2. Tell the children to look for litter on their way home from school. The following day each child is to name one piece of litter and state whether the litter could have been reduced, reused, recycled or placed in a garbage can.
3. Each child is to name one item they reduced, reused or recycled at their home last night (i.e. reusing the back of an old piece of paper for doodling or recycling an empty steel can).

EVALUATION:

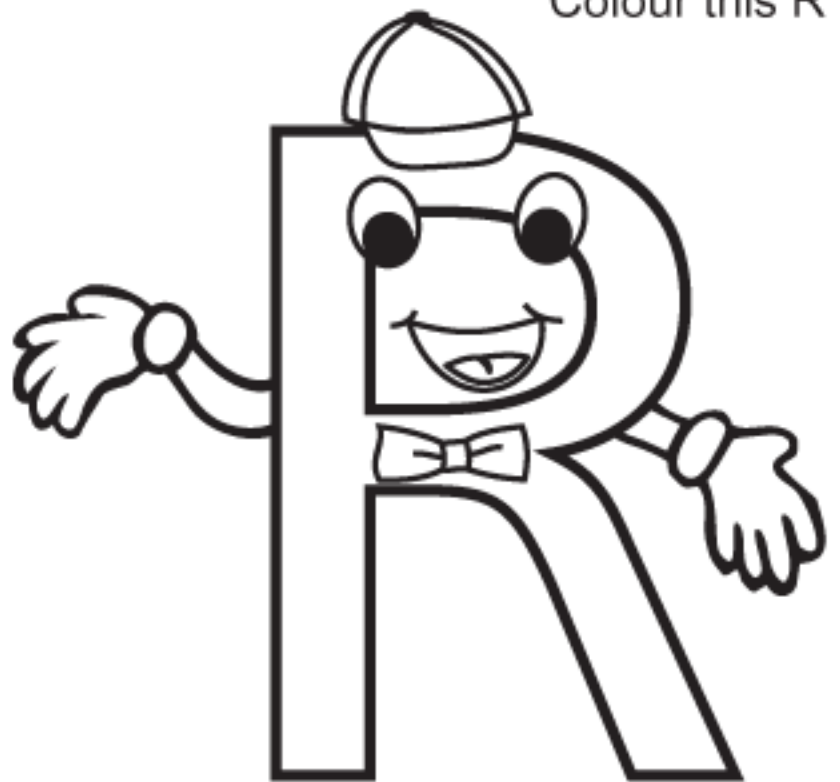
1. Ask the children to recite the 3 R's and then draw the letter three times.
2. Have the children explain why garbage and littering is bad for the Earth.
3. Ask the children if they practiced the 3 R's and remembered not to litter.

The 3 R's



Trace this R

Colour this R



Now make
your own R



The Litter Side of Things

OBJECTIVE: To introduce the idea of waste management by having the children understand garbage and littering. Children will learn to think about the waste they produce and how littering affects their environment.

MATERIALS: chalkboard or easel, shopping bag full of litter/waste (you may wish for the contents of the bag to be litter the children have collected from the school yard), HANDOUT: **Saw Some Litter** (A27)

VOCABULARY: litter, garbage

BACKGROUND:

Littering is more than just a bad habit; it is a poor form of waste management. When a person litters he or she is perpetuating a stereotypical attitude. This attitude is sometimes called the "throw-away mentality". People buy, use and discard items without any thought to the consequences. No thought is given to reducing their waste production. They do not learn to recover a valuable portion of their waste through reuse or recycling. Worst of all these people do not take responsibility for their own waste. By teaching people not to drop their garbage on the ground they become more aware of what garbage is, learn how individual actions can affect the community and gain a better understanding of the environment.

PROCEDURE:

This activity is based upon the sing-a-long game "I Wrote A Letter To My Love".

1. Write the lyrics on the HANDOUT: **Saw Some Litter** (A27) on a chalkboard or easel. Assemble the class into a group in front of the lyrics. Read the lyrics to the class then have the class read them out loud together.
2. Sing the song once to the class. Now have the entire class sing along. Do this until you are comfortable with the students ability to recite the lyrics.
3. Ask the class to form a circle with the children facing inwards. One child is chosen to start the game. The child walks around the outside of the circle as the other children close their eyes and sing the song.
4. The child walking around the outside of the circle carries the shopping bag marked Litter or Garbage. Just before the song ends the child places the bag behind one of the children in the circle. The child moves a few steps away (enough for a head start) from where they dropped the bag and waits. When the song is over the children in the circle turn around to see where the bag was left.
5. The child who has the bag behind him or her gets up and chases the child who left the litter, in a clockwise direction around the circle. If the child who left the bag can race around the circle and get to the spot vacated by the second child he/she is free. The second child then has to pick up the bag and repeat the exercise. If the first child is caught and "tagged" by the second then the first child must repeat the activity.

The Litter Side of Things (cont.)

PROCEDURE (cont.)

6. Repeat Steps 3 to 5 until satisfied with results.
7. When the game is over ask the pupils to explain what should be done with garbage. Emphasize the idea of putting waste in garbage cans.

EXTENSION:

1. Ask the class to think of other things to do with their waste. Specifically, discuss the ideas of reduce, reuse and recycle.
2. Have the class participate in writing a letter to Mother Nature. The letter could explain what the children have learned about littering and what they are doing to stop littering.
3. Tell three students to each look for two types of litter (i.e. candy bar wrapper, pop can, old newspaper) on their way home from school. The following day have the students tell the class what they saw. Pick another three students and repeat the process until the entire class has participated.

EVALUATION:

1. Ask students why litter is bad.
2. Ask the class what a person should do with his or her garbage.
3. Do the students understand what makes sorting the garbage from the recyclables necessary?

Saw Some Litter

*Sáw some lítter ín the yárd
and pícked ít úp to bríng ínsíde
But w'hén I túrned to fínd some móre
Someóne stóle ít and só I críed.*

*I'll lóok ín hére
I'll lóok óver thére
And lóok to see w'ho's gót ít.
So dróp ít, so dróp ít
and lóok to see w'ho's gót ít.*

Brewster Facts

1. The environment is the air, water and land that surrounds us. The environment provides us with oxygen to breathe, water to drink and food to eat. It also provides these things for animals and plants.

2. All the things we eat, drink, breathe or use are called resources. Trees are resources. Oil is a resource, too. The Earth only has a certain amount of some resources. These are called non-renewable resources. Once they are used they cannot be replaced. Other resources can be used over and over again. These resources are renewable.

3. There are so many people living on this planet that all resources and the environment are in danger. We are using non-renewable resources too fast. We are throwing away resources that are still useful. We are polluting the air, water and land we need to live.



4. Part of the problem is waste. Waste is the unwanted material left over from people's activity. Food scraps are waste. Old broken cars are waste. Anything a person uses then throws away is waste. Most waste is buried in the ground. Waste uses resources and creates pollution.

5. There are three ways to stop making too much waste. They are Reduce, Reuse, Recycle. Together they make up the 3 R's.

It's A Small World

OBJECTIVE: To explain the concept of an ecosystem and how pollution affects our environment.

MATERIALS: 2 aquariums or large restaurant type jars, gravel, soil, blooming plants, snails or insects (such as towbugs, millipedes, and earthworms), water, contaminants (such as: vinegar, salt, motor oil or other non-hazardous items), **HANDOUT:** Ecosystem at Work (A33)

VOCABULARY: ecosystem, pollution, transpiration, condensation, percolation

BACKGROUND:

Our environment is a complex web of air, water, soil, plants, animals and a host of other resources. Through direct and indirect links if one resource is affected all others are too. If a tree is cut down a home is lost for small animals, a source of oxygen is gone and a barrier against soil erosion is removed. These ramifications in turn create even more troubles.

Pollution travels along links in the environment creating more pollution. Certain air emissions rise into the atmosphere to become air pollution. Some of the pollution attaches to water droplets then falls back to the ground as rain. The polluted rain falls on the land creating, through percolation, soil pollution and into bodies of water creating water pollution. It is important to think about the widespread problems pollution or other environmental change can cause.

PROCEDURE:

1. Ask the children to search for an article in newspapers or magazines about pollution. A parent or guardian should help the children. Give them a week to find an article.
2. Each child should read the article with an adult and be able to explain what caused the pollution (oil spill, air emissions, nuclear power), where the pollution occurred (Canada, Atlantic Ocean, atmosphere, etc.) and what kind of pollution it was (air, water, soil, etc.).
3. Discuss pollution with the class. Ask a number of children to explain what they read about in their article. Now explain the idea of an ecosystem. Be sure to mention how plants, animals, people, air, water and soil are all interconnected in an ecosystem. Use the **HANDOUT:** Ecosystem at Work (A33). The Biosphere in Arizona is a good example of an ecosystem.
4. The class now builds two mini-ecosystems. Two aquariums are the ideal containers; the children can see the project in cross section. Place 3 cm of gravel at the bottom of each container and then add soil to a depth of 5-10 cm. Add healthy plants to each ecosystem. Blooming plants are preferred as they will better illustrate the difference between the two ecosystems. Snails or bugs could be added to the first container. It is not suggested to add these organisms to the second container as they will be killed by the next step.

It's A Small World (cont.)

PROCEDURE (cont.)

5. Start both ecosystems with plenty of sunlight and a regular supply of clean water. Tell the children to observe how both ecosystems thrive. After a period of time, add clean motor oil or other non-hazardous items such as vinegar, salt or lemon juice to the water of the "bugless" container. The children should note the difference appearing between the ecosystem supplied with clean water and the one contaminated with "dirty" water.
6. Continue to maintain the aquarium until the polluted ecosystem is no longer productive (i.e. plants are dead).
7. Discuss with the class how the water pollution affected the ecosystem.

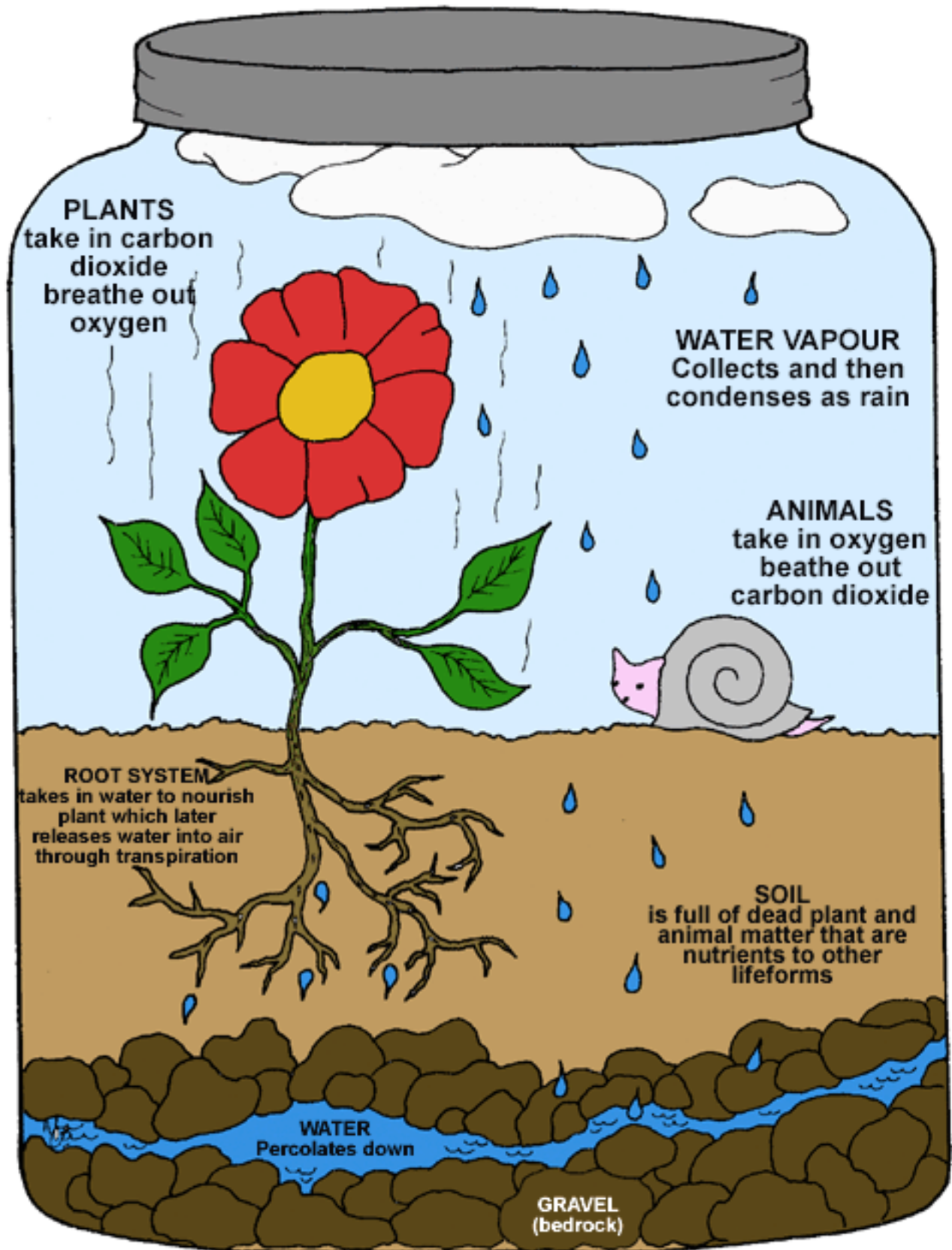
EXTENSION:

1. Ask the children to think about what happens when used motor oil is dumped onto the ground.
2. Discuss a source of pollution found in or near the school community.

EVALUATION:

1. Ask the children to name three types of pollution.
2. How does the material put on our lawns affect the Earth?
3. Other than newspapers what other sources of information about pollution are available?

Ecosystem at Work



One, Two, Tree

OBJECTIVE: To illustrate the importance of forests to the Earth.

MATERIALS: HANDOUTS: Can't see the Forest For the Trees (A37), Things Made From Trees (A38), More Trees Please (A39)

VOCABULARY: reduce, reuse, recycle, packaging, oxygen

BACKGROUND:

Trees do more for the Earth than supply shade and look nice. Forests provide us with the oxygen we breathe while removing the carbon dioxide we exhale. An uncountable number of animals and insects call the Earth's trees and forests home.

The Saturday edition of the Toronto Star is, on average, 200 pages. It requires 8,330 trees to make the 750,000 copies of the paper printed each weekend. While some paper products are necessary, a lot of the paper we consume is the result of excess packaging or wasteful habits. Forests need time to replenish themselves. We must balance our needs with those of the trees and animals living in the forests.

PROCEDURE:

1. Ask the class how many of them have been for a walk in the woods. Ask them to think about all of the things that depend on the forest to live. Use the HANDOUT: Can't See the Forest For the Trees (A37) to stimulate their thinking.
2. Have the children think of all the things they use each day that are made from trees. Have them fill in their ideas on the HANDOUT: Things Made From Trees (A38). Discuss how to reduce the amounts they use.
3. Now have the class do the math problems on HANDOUT: More Trees Please (A39).

EXTENSION:

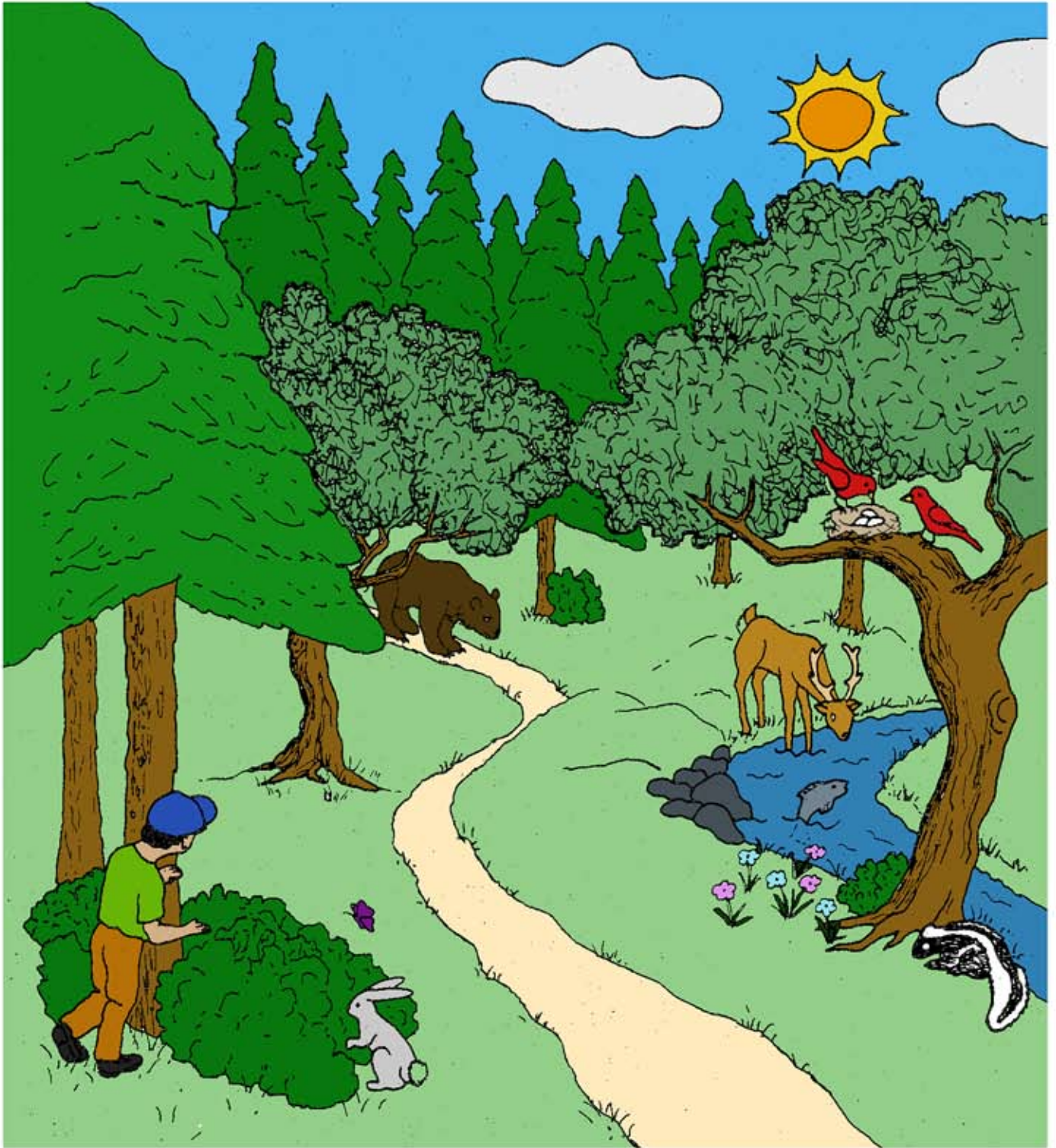
1. Ask the class to think of ways to save trees (i.e. writing on both sides of the paper, avoid excess packaging, recycle newspaper).
2. Inform the class that trees are one of many natural resources. Ask them to think of other resources.
3. Start a tree planting campaign.

One, Two, Tree (cont.)

EVALUATION:

1. Have each student write down why trees are important.
2. Ask the students what they are going to do to slow their own consumption of tree related products (paper, wood, etc.).
3. Have the students create a word problem involving the area of the average backyard (20 m x 30 m) and the average density of trees in a forest (500 per hectare).

Can't See the Forest For the Trees



What is a forest to us, other animals and the Earth?

Things Made From Trees



Newspaper
Box Board
Corrugated Cardboard
Fine Paper
Magazines
Furniture
Insulation

Books
Comics
Paper Towels
Toilet Paper
Facial Tissues
Greeting Cards
Animal Bedding

Houses
Sheds
Barns
Envelopes
Fences
Catalogues
Wall Board

More Trees Please

1. Imagine all the paper and wood items you use each week. If it takes one tree to make these items how many trees would you use in a year?
2. How many trees would your whole class, including the teacher, use in a year?
3. If a tree has enough wood to make 50 baseball bats, how many bats would 28 trees make?
4. Ninety-six trees are found on a small plot of land. A person operating a chain saw can cut down 12 trees per hour. How many hours would it take before all the trees are cut down?

Brewster Facts

1. The Earth is home to 5 billion people. Every day each person produces waste. By definition, waste is the discarded or unwanted by-products of human activities.
2. Waste can be biodegradable or non-biodegradable and occurs in any of the three physical states: solid, liquid or gaseous.
3. A small percentage of the total waste generated is unavoidable; it is the product of nature. Leaves, fallen trees and animals that have died from natural causes are examples of unavoidable waste. However, the waste that is causing the environmental crisis we all face is the result of our personal habits.
4. Industrialized nations with high standards of living are driven by consumption. People buy goods or services, use them, discard them and then purchase more goods or services. Buying more and more items keeps factories and business running. The problem is we have consumed and discarded to the point where the Earth is in trouble.
5. Natural resources are becoming scarce. We have used or polluted much of the resources the Earth has to offer. These resources provide the air we breathe, the water we need, the food we eat, the homes we live in and the fuel that heats and transports us. If we keep using more and more there will be no resources left.
6. At the same time we are throwing away paper, minerals, fossil fuels and other resources that are still valuable. Not only is this wasteful but all the items we have deemed no longer useful are piling up.
7. While unnecessary waste is a global problem the solution is quite simple. The best way to help the waste situation is to change your personal habits. If everyone tried to fix his or her little piece of the Earth then a global difference would occur. Canadians are the number one waste producers in the world. Each of us produces a tonne of waste every year. It is only fair that we make an effort to help the Earth.
8. The first step is to change our attitudes by Reducing, Reusing and Recycling as much waste as possible. Only if waste cannot be treated by the 3 R's should it be thrown away.

Did you know...
Canadians produce
30 million tonnes
of garbage per
year, making us the
**#1 waste producer
in the world.**
This is not an
enviable position
to be in.



Weighing In

OBJECTIVE: To illustrate the burden waste places on society and to explore methods of lessening this burden.

MATERIALS: garbage bag, air tight container (ice cream tub), weigh scale, rubber gloves, **HANDOUT: Waste in Ontario (A45)**

VOCABULARY: landfill, hazardous waste, tipping fee

BACKGROUND:

Canadians are the number one waste producers in the world, generating 30 million tonnes of garbage annually. Seventy-five percent of this waste is buried in landfills. Landfilling is the least desirable form of waste management; burying waste out of sight does not teach people to be responsible for their own waste. Reduction, reuse and recycling (the 3 R's) allows a person to take an active roll in managing his/her garbage. The 3 R's can divert nearly 75% of garbage from landfills. When an individual understands the components of waste they will understand that only a small portion of waste is truly garbage.

PROCEDURE:

1. Distribute the **HANDOUT: Waste In Ontario (A45)** to the class. Lead a discussion, asking the students to describe typical items that might be found in each waste category (i.e. used batteries are considered hazardous waste).
2. Ask the class if they think the **HANDOUT** is an accurate reflection of their personal waste production. Tell the students they are going to conduct an experiment to test their answer.
3. Each student is to collect the waste he or she produces over a period of one week. Any waste whether it is produced at home, school or even the mall is to be gathered. Some students may practise reduction, reuse, recycling or composting at home but for this activity all of their waste should be collected. Hazardous waste makes up only 1% of total waste production and for safety reasons it should not be included. Food and other organic kitchen waste should be kept in an air tight container such as an empty ice cream tub. The container should be weighed when empty to ensure accuracy later in the activity. All other items are to be placed in a garbage bag. As an option you may wish to have each student actually carry their garbage bag with them everywhere they go during the week. This may provide the students with a better understanding of the quantity of waste they produce.
4. After a week each student is to bring their garbage to the class. The students weigh their bags and record the weight. The container full of organic waste is weighed and the weight of the empty container should be subtracted. By adding the weight of the bagged garbage to the weight of the organic waste the student can total the amount of garbage he or she has generated.

Weighing In (cont.)

PROCEDURE (cont.)

5. The HANDOUT shows 20% of the waste being Yard Organics. Students should take their total waste generated figure calculated in Step 4 and multiply it by 0.20. This will provide an estimate of the yard waste the student would produce in a week. By adding the yard organic figure just calculated to the answer from Step 4 a student will arrive at his or her final waste production figure.
6. The students now separate their individual garbage into the categories found on the HANDOUT: **Waste In Ontario** (A45). Weigh the items in each category and compare it to the totals to determine the percentage of each type of waste.
7. Instruct the class to compare their individual percentages to the provincial averages.
8. All collected waste should be separated into items that could be reduced, reused, or recycled. Briefly explain to the class how composting can reduce most of their organic material. For the purpose of the exercise all of the food collected can be considered compostable; a more detailed explanation of material suitable for composting is found in the Compost chapter (section E).
9. Any waste that can not be diverted using the 3 R's and composting should be weighed. This amount should be used to calculate the potential diversion of each student. For example, if a student produced 10kg and 2kg could not be diverted then their diversion would be 8kg or 80%.

EXTENSION:

1. Add all the class totals and rework the exercise to see how the class would compare to the provincial averages.
2. Prepare a report about the class results and present it to the local Municipal Council to demonstrate how individuals can make a difference in preserving the Earth.
3. If the tipping fee at the local landfill is \$50 per tonne how much money could be saved by the class in landfill costs by utilizing the 3 R's?

EVALUATION:

1. If there were any students who could not reduce their waste significantly, discuss why? (Neglect or the fact that they had already developed "Earth Friendly Habits"?)
2. If this exercise was extended to the community at large would the Ontario Provincial goal of a 50% reduction, in waste going to landfill, by the year 2000 be possible?
3. If the average Canadian produces 1 kg of waste per day how does the students total waste generated in a week measurement and total waste generated after the 3 R's compare? Calculate any differences in percentages (i.e. the student was 30% above the national average waste production of 1kg per day).

Waste In Ontario

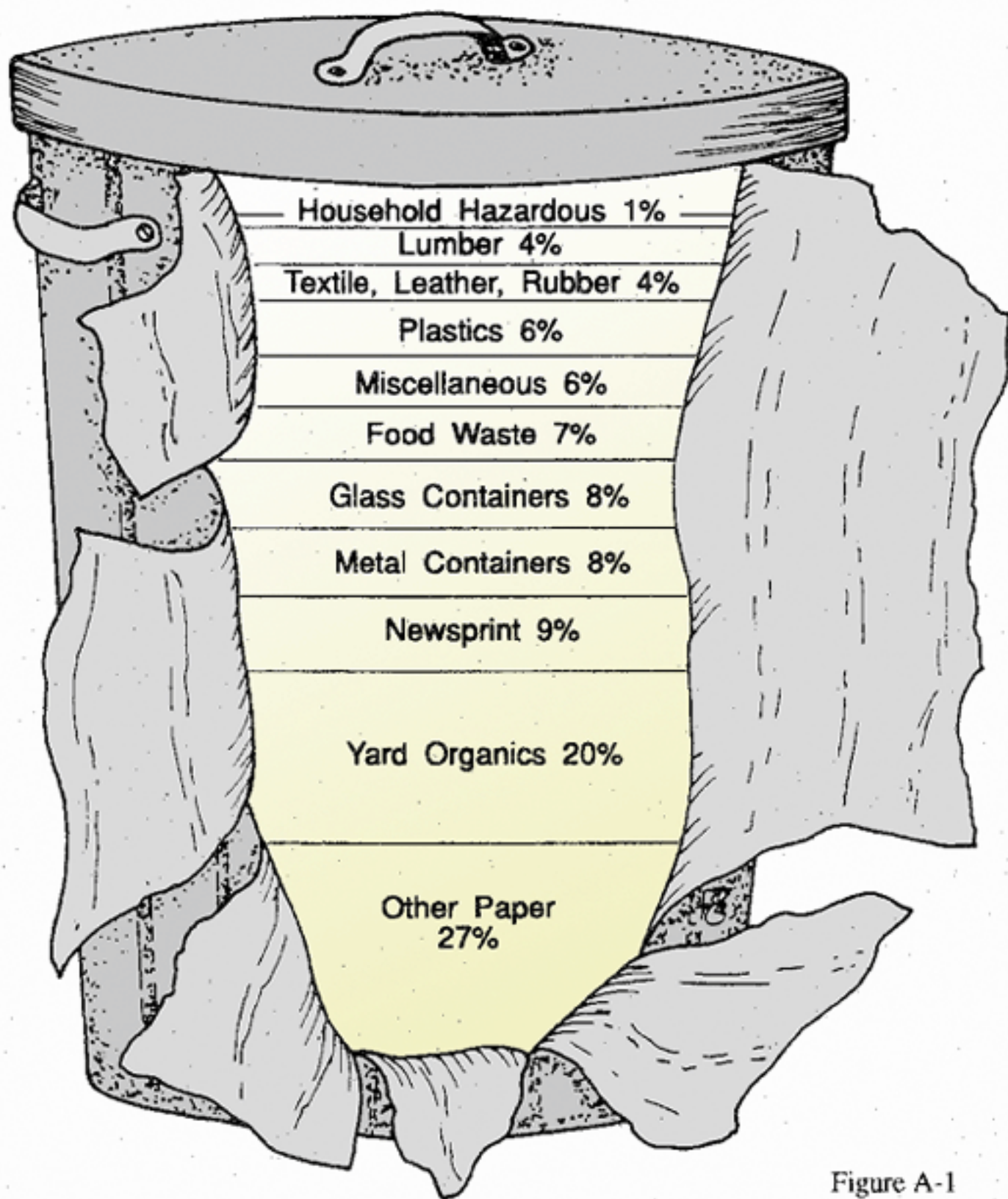


Figure A-1

Natural Resources...Handle With Care

OBJECTIVE: To demonstrate the concept and management of natural resources and energy.

MATERIALS: HANDOUTS: Natural Resources (A49)

VOCABULARY: natural resources, renewable, non-renewable, energy

BACKGROUND:

Canada uses more energy per capita than any other country. Energy is used to heat our homes, light our lights, cook our meals, move people or goods from place to place and even extract more energy. Most of the energy we use is derived from natural resources. Our energy consumption combined with our waste production is straining the natural resources we have while jeopardizing resources we will need in the future. Everything essential for life depends upon natural resources. They provide food, clothing, shelter, medicine and many other items.

Natural resources are divided into two categories: renewable and non-renewable. Water, forests, fish and soils are examples of renewable resources. Fossil fuels, minerals and metallic ores are non-renewable resources. Everyone understands how the quantity of non-renewable resources is a fixed amount; once they are used there will be no more to be had. However, if we use or pollute all of our renewable resources they will not be able to regenerate thus becoming non-renewable resources.

PROCEDURE:

1. Instruct the students to take five items from their desk. Write a definition of natural resources on the chalkboard. You may use the one provided in this book or a definition from a dictionary, encyclopedia etc.
2. Ask the students to name all the natural resources they can think of. Write the suggestions under the definition.
3. Instruct the class to look at the five items they have on their desk. Each student is to consider what natural resources were used to create the item. Tell the students to consider the energy used to make the items. Mention the energy used in harvesting the raw materials, turning these materials into finished products, transporting the items to a retailer and so on.
4. Explain the idea of renewable and non-renewable resources to the class. Write both words on the chalkboard. Take the list of natural resources the class provided in Step 2 and place each suggestion under the appropriate heading: renewable, or non-renewable.

Natural Resources...Handle With Care (cont.)

PROCEDURE (cont.)

5. If the number of suggestions is sufficient, assign a suggestion to each student. A list of natural resources can be found on the HANDOUT: **Natural Resources** (A 49). If the class is too large or the suggestions too few assign a group of students to each suggestion. Each group or student is to research information on the assigned topic. Students are to use three different sources (magazines, textbooks, reference books, filmstrips, cassettes, etc.). Information should include what the natural resource is, how is it harvested, what end products are made from the resource, and the environmental problems associated with mis-managing the resource. Also, the students should find/theorize possible alternatives to the resource and/or solution to the environmental impacts.

EXTENSION:

1. Ask the students to consider the resources and energy wasted when garbage is landfilled.
2. Have the students design a program to reduce the natural resources and energy used in the classroom. Some examples are writing on both sides of the page to save paper, fixing a leaky tap to save water and energy, or caulking a window to stop a draft.
3. Bring two identical lamps into the class. Place a normal incandescent 60 watt bulb in one lamp. In the other lamp use a 13 watt compact fluorescent tube. Leave both lamps turned on continuously (you may wish to use the lamps during school hours only) to see which type of light will run the longest. (Note: Fluorescent bulbs use roughly 70% less energy than incandescent bulbs.)

EVALUATION:

1. Ask the students if natural resources should be sold to other countries (i.e. Canadian water diverted to the United States).
2. Ask the students to think of ways to conserve natural resources and energy in their home.
3. Have the class list sources of research information and where these sources could be found (library, college, secondary school, private enterprise, government services, etc.).

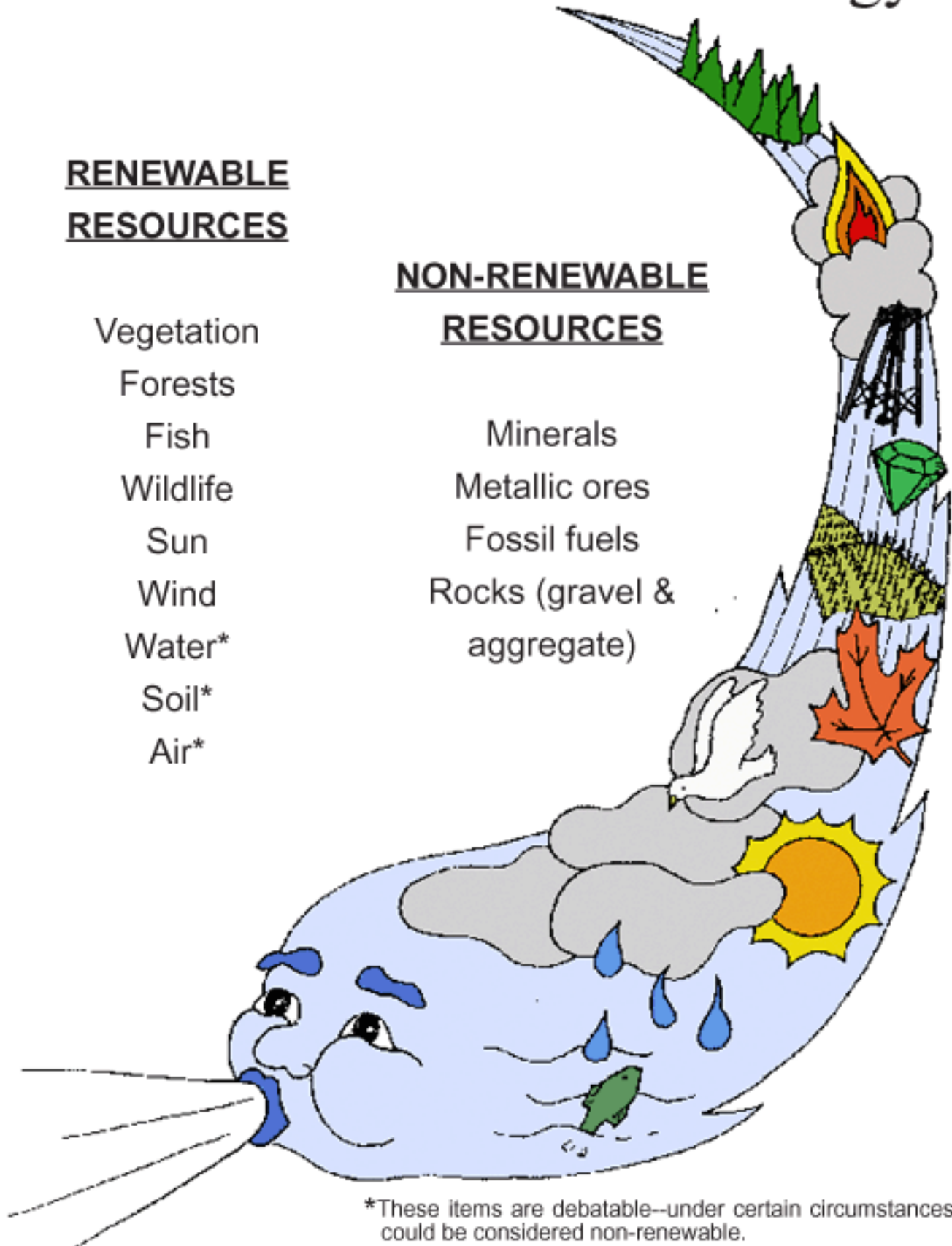
Natural Resources & Energy

RENEWABLE RESOURCES

Vegetation
Forests
Fish
Wildlife
Sun
Wind
Water*
Soil*
Air*

NON-RENEWABLE RESOURCES

Minerals
Metallic ores
Fossil fuels
Rocks (gravel & aggregate)



*These items are debatable--under certain circumstances they could be considered non-renewable.

WASTE OVERVIEW

Ecotalk

CONDENSATION - to form liquid from tiny water drops in the air.

ECOSYSTEM - is a group of living things (people, animals, insects, plants) and there non-living surroundings (soil, water, air, rocks, etc.). An aquarium is an ecosystem and so is the Earth.

ENERGY - is the power used to move vehicles, light lights, and heat homes. Gasoline, propane and the sun all provide energy. The food we eat gives us the energy to breath, walk, talk, etc.

GARBAGE - is the part of waste that cannot be reduced, reused or recycled.

ENVIRONMENT - is the air, water and land that surround us.

HAZARDOUS WASTE - is waste that is very dangerous to a person's health or the environment. Poisons and old medicines are hazardous waste.

LANDFILL - is a pit or hole in the ground used to hold garbage.

LITTER - is waste people throw away. Pop bottles tossed out of car windows and candy wrappers dropped on the sidewalk are litter.

NATURAL RESOURCE - are things made by the Earth. They include water, soil, rocks, plants and many other items. Some natural resources can used be more than once. Others resources can only be used once. These are non-renewable resources. Resources are important because without them we cannot live.

NON-RENEWABLE - means not capable of being naturally restored or replaced.

OXYGEN - is a gas given off by plants that people and animals use to breathe.

PACKAGING - is the wrapping around a product.

PERCOLATION - is water or another liquid flows through a substance. For example, water on the beach percolates through the sand.

POLLUTION - is caused by people being careless with waste. Pollution makes the air, land, and water dirty. This hurts people, animals, natural resources and the environment.

RECYCLE - is the third "R". Recycling occurs when people collect and separate a special part of their waste. The part is special because it can be used to make new items. Old steel cans be recycled to make new steel cans.

WASTE OVERVIEW

Ecotalk (cont.)

REDUCE - is the first "R". Reduce is easy; all you have to do is make as little waste as possible.

RENEWABLE - is something capable of being naturally restored or replaced.

REUSE - is the second "R". Reuse means to use the item more than once instead of throwing it away. For example, plastic ice cream containers can be reused to hold plants.

TIPPING FEE - is the money a person has to pay to leave garbage at a landfill site.

TRANSPIRATION - a plant gets water from the ground through the plants roots. Extra water is released by the plants leaves. When the water is released this is transpiration.

WASTE - is the things left over from people's activity. Food scraps, old newspapers, grass clippings and many other things are waste. Most waste can be reduced, reused or recycled. Only a very small portion is truly useless; this is called garbage.

WASTE OVERVIEW

Glossary

ACID RAIN: precipitation with a higher than normal degree of acidity due to the absorption of sulphur dioxide gas and nitrous oxides.

AEROBIC: taking place in the presence of oxygen.

AGE OF ENLIGHTENMENT: an intellectual movement of 18th century Europe which questioned traditional beliefs and prejudices. This movement also introduced the use of strict scientific method.

AGRICULTURAL REVOLUTION: the relatively abrupt change, which first occurred an estimated 10,000 years ago, involving domestication of plants and animals.

ANAEROBIC: taking place in the absence of oxygen.

BIODEGRADABLE: a term describing a substance or material which can be broken down into simpler compounds by micro-organisms.

BLUE BOX: a blue plastic container distributed to households. Most Blue Boxes are made of recycled plastic and can be recycled.

CHLOROFLUOROCARBONS: a chemical composed of chlorine, fluorine and carbon atoms. CFC's breakdown the stratospheric ozone faster than it can be naturally replaced.

DEGREE OF ACIDITY: a measure of the effective concentration of hydrogen ions in a solution of a given substance. Acidity is measured on a pH scale, with pH 14 being alkaline, pH 7 neutral and pH 1 as very acidic.

ECOSYSTEMS: the interacting system of a biological community and its nonliving surroundings.

EFFLUENT: liquid waste (i.e. leachate, sewage).

FOSSIL FUELS: fuels from once-living matter; for example, coal, petroleum or natural gas.

GLOBAL WARMING: an increase in temperature around the world caused by the build up of carbon dioxide in the air.

GREENHOUSE EFFECT: describes the build-up in the atmosphere of pollutant gases which will not allow heat coming from the earth to escape into space.

INDUSTRIAL REVOLUTION: the mechanization of industry and the consequent changes in social and economic organization.

INFRARED RADIATION: electromagnetic waves of length greater than visible light and perceived as heat.

LANDFILL(S): a pit or depression in the Earth's surface into which garbage is placed. Old landfills were called dumps. Modern landfills are engineered for safety.

WASTE OVERVIEW

Glossary (cont.)

LEACHATE: liquid formed when precipitation infiltrates the soil covering a landfill, percolates down through the waste, picking up a variety of suspended and dissolved materials.

METHANE: a colourless, odourless, flammable, gaseous hydrocarbon that is the product of the anaerobic decomposition of organic matter. It can be burned as fuel.

NITROUS OXIDE: a colourless gas with a sweet smell, used as an anaesthetic (laughing gas).

NONBIODEGRADABLE: not capable of being broken down by micro-organisms.

NONRENEWABLE: not capable of being naturally restored or replenished.

OZONE: a gas and a variant of oxygen containing three molecules rather than two. (O₃)

PARTICULATE MATTER: very small pieces of solid matter or droplets of liquid suspended or carried in the air.

PLANNED OBSOLESCENCE: the practice of producing goods that have a very short life, in order to ensure more goods will have to be purchased and produced; the process perpetuates consumption.

RENAISSANCE: the artistic, literary and scientific revival which began in fourteenth century Italy and was typified by the spread of humanism and objective scientific inquiry.

RUN OFF: water, originating as precipitation, flows across the surface of the ground rather than soaking into it and eventually enters bodies of water; carrying a variety of substances.

SEPTIC TANK: a tank in which sewage is broken down by anaerobic bacterial activity.

SLAG: non-metallic waste matter obtained when ore is smelted.

SYNTHETIC: man-made or produced by a chemical process rather than of natural origin.

TROPOSPHERIC OZONE: range of the Earth's atmosphere extending from ground level to a height of 8-15 km. Contains most of the atmospheric moisture and is the region where wind and clouds are formed.

TURBIDITY: haziness in the atmosphere due to pollution or murkiness in water due to suspended material.

WASTE MANAGEMENT HIERARCHY: handling or controlling waste in a descending order according to preference, with reduction being most favourable.

WASTE STREAM: all of the waste generated in the processes of production, utilization and disposal of goods; the total waste produced by a community or society as the waste moves from origin to disposal.

WEeping TILE BED: the dispensing of water through perforated drainage pipes in a concentrated area allowing for even absorption of liquid.