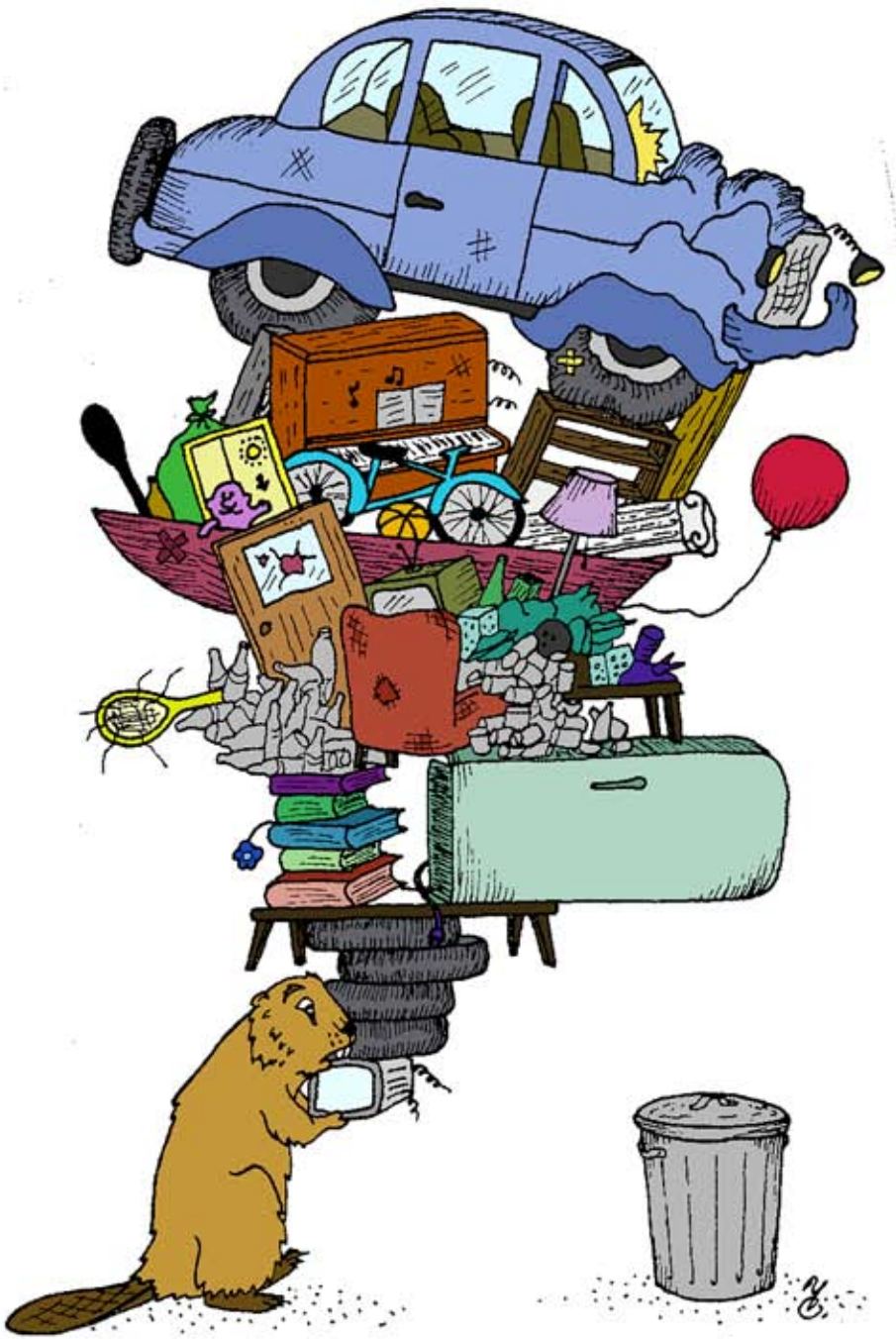
DISPOSAL



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Disposal

Too much of anything is bad for an individual. Too much food, too much exercise, too much sleep will keep one part of the body happy while adversely affecting another. A healthy, strong person is one who achieves a balance. Because it is the only planet that we know of to sustain life, the Earth could be considered an individual. It too, requires a balance for its well being. In the area of waste management, it is receiving more than a healthy amount of the last step in the waste management hierarchy: disposal.

Used correctly, disposal is not a problem. The fact is, disposal is a necessary method of handling waste. Some material cannot presently be reduced, reused, recycled, or recovered. Instead of throwing this material anywhere, disposal arranges it in a neat and orderly fashion. But, there continues to be an over emphasis on the use of disposal for handling our garbage.

Disposal
is traditionally the final stage
of the waste management process,
where waste is discarded in a landfill or similar facility.

The new focus of disposal has shifted to the temporary storage of residual resources, that given present technology cannot be processed to an acceptable quality. Upon the development of new technologies, the resources will be extracted for processing.

There is really only one practical method of disposal and that is landfilling. Waste can be treated prior to disposal in a variety of ways but ultimately it is placed in the ground. The disposal chapter will examine the different treatments first, then explore the various types of landfills.

In industrialized nations, speed and convenience are necessary; time is money. Ever quickening lifestyles have created a "consume and discard" way of thinking. There is no time to worry about what happens to the things we used in the past because we are in a rush to get to the future. From a waste standpoint this means tossing garbage in bags and leaving them at the curb. The dependence upon disposal to deal with our waste is letting the past pile up. If something is not done soon, the past could come back to haunt us.

Treatment

Once upon a time, waste was off-loaded directly from the collection vehicle into the landfill. Except for being slightly compacted, the garbage was laid to rest in the same state it was collected. When landfill space was plentiful, this practice worked fine. As existing landfill sites neared their capacity and the locating of new sites received increased resistance, better methods of landfilling were needed. Pre-disposal treatment of waste was one solution.

Imagine, a landfill as a suitcase. Both have clearly defined bottoms, sides, and tops which allow a certain volume of materials to be safely stored. This space is finite. Now picture two suitcases. In each, the identical number of items will be placed. Goods going into the first case are tossed in, rumpled and unorganized. Items in the second case are neatly folded and piled. When it comes time to close both cases, the disorganized one is a little difficult to shut. The neatly arranged case not only is easy to close, but also has a little extra room. By preparing waste before it is buried, landfills resemble the second suitcase; they are organized in a manner that allows the maximum number of items to be stored in given volume.

With an understanding of why waste should be treated before disposal let us now look at how it is treated. The first method is the incineration of waste. Incineration is not to be confused with *Energy-From-Waste* combustion or other recovery methods involving burning. In the context of disposal, incinerating garbage is used as a volume reduction technique. As mentioned in the Recover chapter, the burning of waste can reduce its volume by 70 - 90 percent. In theory, a landfill can hold nearly ten times more waste if it is incinerated. Logically, this extends the landfill's useful life.

Safety is another reason for pre-disposal burning. *Biomedical waste* and hazardous materials have the potential to cause serious health risks; proper disposal of these items is crucial. Special *incinerators,* different from those used to burn municipal solid waste, are employed to make biomedical and *hazardous waste* fit for disposal. In the case of the latter, the extreme heat inside the incinerator triggers a chemical reaction. Hazardous products are broken down into less hazardous components. Ash captured by the incinerator's pollution control equipment, is then placed in a sanitary landfill, secured landfill or *monofill*; depending on government legislation. The ash is said to be less toxic when compared to the original waste and the volume has been reduced.

Biomedical waste requires special treatment. For aesthetic and health reasons, laboratory and infectious waste, body tissues and fluids plus blood saturated materials (i.e. dressings and gauze sponges) are incinerated. Old hospital incinerators were used to burn almost all of the garbage produced by health care

Treatment (cont.)

facilities. Improved government legislation in the province of Ontario has limited the types of material that may be burned while improving pollution control equipment requirements. The heat involved in the incineration process kills any *pathogens* or other health risks found in the biomedical waste while converting waste components (body tissues, used dressings) into a uniform, acceptable ash. The high cost of operating individual incinerators may see Ontario hospitals use regional incinerators instead. Although, only 10% of medical refuse needs to be burned, the pre-disposal treatment of biomedical waste is a necessary safeguard.

Another option in the handling of biomedical material is the use of an *autoclave*. This process involves the application of pressurized steam to sterilize medical waste, excluding body tissues. Micro organisms, bacteria, and other elements are killed by the autoclave. The treated waste is now suitable for landfilling. Drawbacks associated with this type of procedure are as follows: the volume of waste is not reduced and autoclaving as of yet, cannot process the same quantity of material as quickly as incineration.

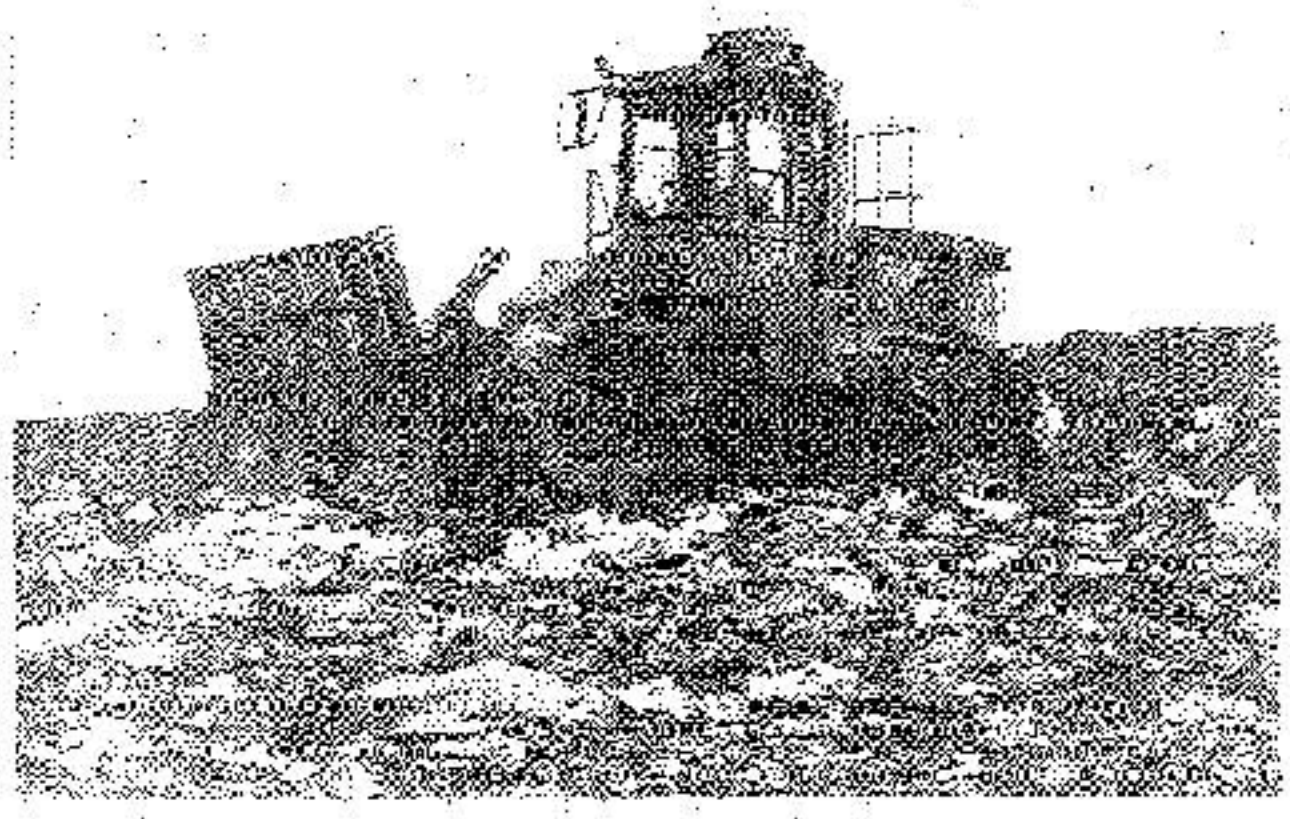


Figure G-1

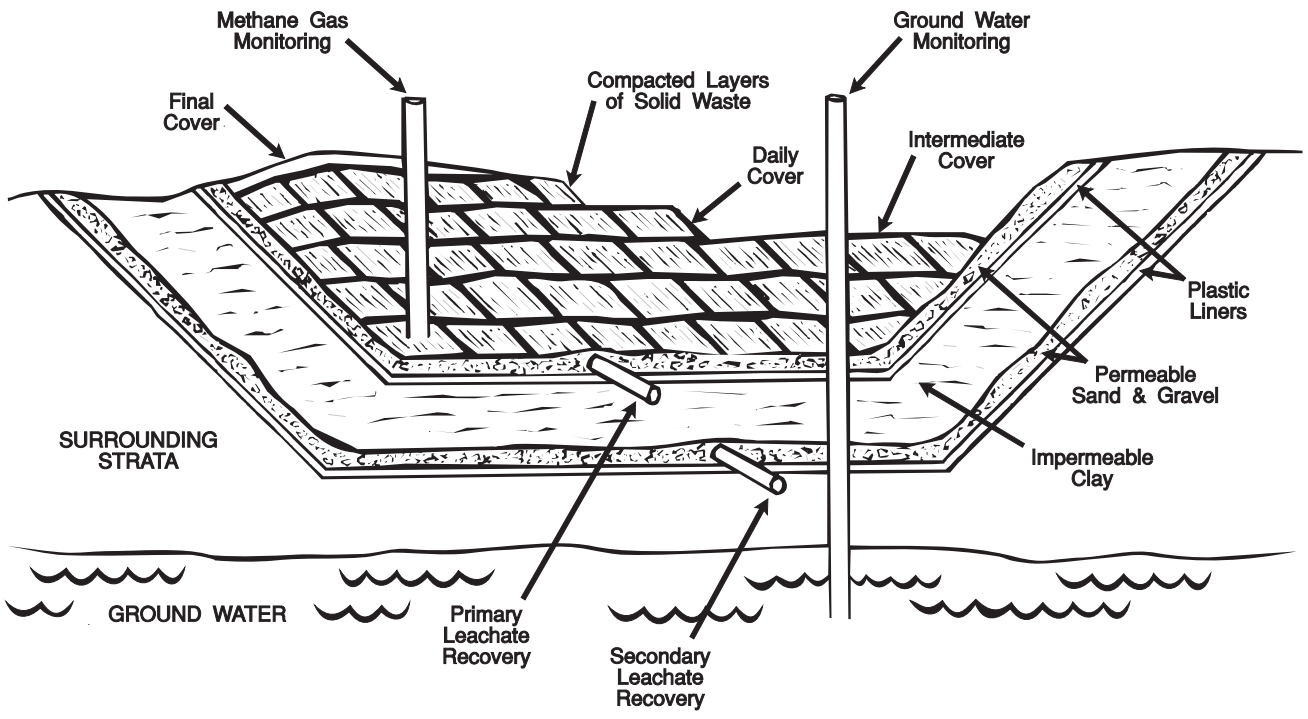
Everyday waste can also be better prepared for landfilling. Municipal solid waste may be incinerated, shredded or *baled*. The benefit of incineration, a reduction in volume, has been well documented so we will not discuss it any further. Shredding tears or cuts garbage into small pieces; the process is similar to the grounding of meat into hamburger. Excess air in landfills is avoided because shredded material compacts much easier than large bulky waste. Heavy equipment (Figure G-1) is needed to ensure the material is compacted properly otherwise shredded waste takes up more landfill space than regular solid waste. Like a feather pillow, the non-compact shreds appear light and fluffy but once pressure is applied they stack into a compact mass. Baling is an attempt to make waste more compact also. Refuse is densified into tight bundles then carefully arranged in near rows in the landfill. The uniform size and shape of the bales allow the garbage to be stacked vertically, much like bricks. Although an expensive pre-disposal treatment, baling creates clean landfill operations. Cover, soil used between daily landfill deposits, typically makes up 30% to 50 % of the volume in a landfill. Baling reduces the need for cover, thus maximizing landfill space.

Waste, slated for disposal, needs careful preparation. The suitcase analogy mentioned at the beginning of this section sums up the need to carefully "pack" the portion of waste that must be landfilled. Unlike personal belongings, most communities do not care if their waste goes somewhere else. However, this is irresponsible; no one should dump a case of waste in someone else's place. The final point is, the Earth already has enough luggage, five billion people for example, to carry; it does not need any more.

Landfills

What is the world's largest man-made structure? No, it is not the pyramids of Egypt. The C.N. Tower is not the answer either. The largest structure built by mankind is the Fresh Kills Sanitary Landfill. Located in Staten Island, New York, the site is 45 meters high, 45 meters deep and covers an area of 120 hectares! This would seem surprising at first but is less shocking upon looking at some statistics. In Ontario, 75% of all waste is sent to landfill. If this figure was representative of Canada as a whole, 22,500,000 tonnes of garbage would be buried. Piled on a football field, 1.2 meters in depth, it would require 6,000 fields to hold all the waste. Placed end to end, the fields would stretch from most of the homes in the Bluewater Recycling Association's service area to Toronto, four times.

Modern landfills, are well-engineered homes for waste that cannot be reclaimed by stages higher up the waste management hierarchy. Landfills are often misunderstood. While it is obvious we rely upon them too heavily and they are necessary as a last resort, much of the negative feelings towards landfills stems from the past. The forerunner of a landfill was the dump. Webster's Dictionary refers to the verb "dump" as "to get rid of" and this is exactly what happened. Garbage was disposed of on any cheap and convenient piece of land; waste was dumped into the ground. Pest control, litter, soil, and water contamination were not of any real concern. People began to associate dumps with rats, seagulls, poor drinking water, and foul smells. Gradually these problems were rectified, resulting in the creation of landfills. In the past, dumps took all wastes; industrial, commercial, and hazardous household materials. Landfills are now designed and regulated to hold specific materials. This has led to the creation of three general types of landfills: sanitary landfill, secured landfill, and monofill.



CROSS SECTION OF A MODEL SANITARY LANDFILL

(Each Landfill is engineered according to the specific characteristics of its physical and geographical setting)

Landfills (cont.)

Sanitary Landfill:

As the problems associated with dumps became evident, government bodies drafted guidelines to better control the disposal of waste. In Ontario, the result was Regulation 347 of the Environmental Protection Act.[1] Overseen by the province's Ministry of Environment and Energy (M.O.E.E.), sections of the regulation specify the requirements modern landfills must meet.

All landfills must have some level of engineering, both for the protection of the environment and for aesthetic reasons. The specific protection required is determined on a case-by-case basis; each landfill is judged individually based on the waste it is to contain and the geographical properties of the area. The degree of engineering depends upon the landfill's ability to meet the M.O.E.E.'s groundwater contamination and discharge limits. Gas and leachate are the two major problems landfills generate. Landfill gas is roughly 50% carbon dioxide and 50% methane. It is the methane that poses the greatest danger; the gas becomes explosive when mixed with oxygen. Without proper control, methane can seep into pipes and buildings. Homes built near old, improperly constructed landfills have exploded from methane leaks.

Leachate starts as rain or other precipitation. Upon falling on a landfill, or flowing past as surface water, the moisture passes down into the landfill. As water moves through the waste, metals, soluble chemicals, suspended particles and other contaminants are gathered by the liquid. Unless measures are taken, these pollutants end up in groundwater and bodies of surface water (lakes, rivers). In general, the Ministry prefers sites that have a high degree of natural protection against environmental damage.

So, what makes a sanitary landfill so special? Let us start from the bottom and work our way up. For illustration purposes we will use a model that requires a complete range of engineered protection. At the very bottom of the landfill is a layer of bedrock or compacted soil. Preferably, this base would be a clay soil. Clays have physical properties which inhibit the movement of water. This is useful in a landfill, as the water percolating through the waste can carry contaminants into groundwater supplies.

Rolls of synthetic, *impermeable* membrane liner are placed on top of the soil/bedrock. When sealed together, the rolls form a large "bowl". Again, this protection is used to limit the flow of leachate out of the landfill. Immediately above the liner is a layer of sand or gravel and the leachate collection system. Liquids that cannot penetrate the liner accumulate in the sand/gravel. A network of pipes buried in this material allow leachate to be drawn up and out of the landfill. The liquid removed is treated as sewage, to allow for its safe disposal. Lying on top of the leachate recovery layer is a bed of clay. As mentioned, the clay is helpful in controlling the downward movement of liquid. Another synthetic membrane bowl is placed over this clay layer, then a second leachate collection system in a bed of sand/gravel.

Groundwater monitoring wells and methane gas monitoring equipment are inserted into the landfill before waste is added. Water samples are taken, while the site is empty, as a benchmark of groundwater quality; future samples will be measured against the initial sample.

Now the landfill is ready to accept waste. Refuse is placed in a small working area called cells. Layers of garbage are compacted using heavy equipment, such as a packer tractor, in a cell before being covered with

Landfills (cont.)

soil at the end of each day. Daily cover keeps odours, pests, contamination, and litter to a minimum. When a sufficient number of cells have been completed a layer of soil called intermediate cover is added. This allows the landfill workers and their equipment to start on another series of working areas. Once enough layers of cells have been filled, to complete the landfill's capacity, a top cover is placed above the last row of cells to seal the site. Grading of the cover and ditches controls surface water run-off. Berms and trees are used to make the perimeter of the landfill visually appealing. Fences and locked gates ensure illegal dumping or mishaps are avoided during non-operating hours.

Many landfills, today, refuse to accept material that can be recycled. Others do not take commercial/ building/demolition waste. The materials accepted by the site depends upon what the M.O.E.E. has licensed; the Ministry establishes what each facility is allowed to receive. In the case of hazardous waste, a secured landfill is the only type of landfill legally allowed to take this material.

Secured Landfills

A portion of our waste stream consists of materials that are *toxic, corrosive, flammable, reactive,* or *radioactive*. Homes, industry, and agriculture all contribute to this type of waste. Because of the dangers associated with the properties mentioned, the material is called hazardous waste.

An entire chapter of this book has been dedicated to this topic, including a detailed examination of a secured landfill. Rather than repeat the information, a short summary will be provided.

If a regular landfill could be considered a jail for waste, then a secured landfill is a maximum security prison. It contains everything found in a sanitary site, only to a higher degree. Waste is treated prior to disposal. The landfill must have all the leachate/pollution control measurements found in a sanitary landfill. A secured landfill must be located in a geologically stable area that possesses the ability to safely contain materials and protect groundwater for thousands of years. At present, the only facility licensed to accept hazardous waste in Ontario, is located south of the city of Sarnia.

Monofills

Ash produced during the *combustion* or incineration of waste may be buried in a sanitary landfill. In some areas the ash is considered unsafe (high heavy metal content etc.) so it is placed in an ash-only landfill. This type of facility is called a monofill. The prefix "mono" comes from the Greek word for single, monos. So, a monofill holds a single kind of waste. By placing ashes in a special facility, the contaminants in the material can be monitored and controlled better than in a regular sanitary landfill.

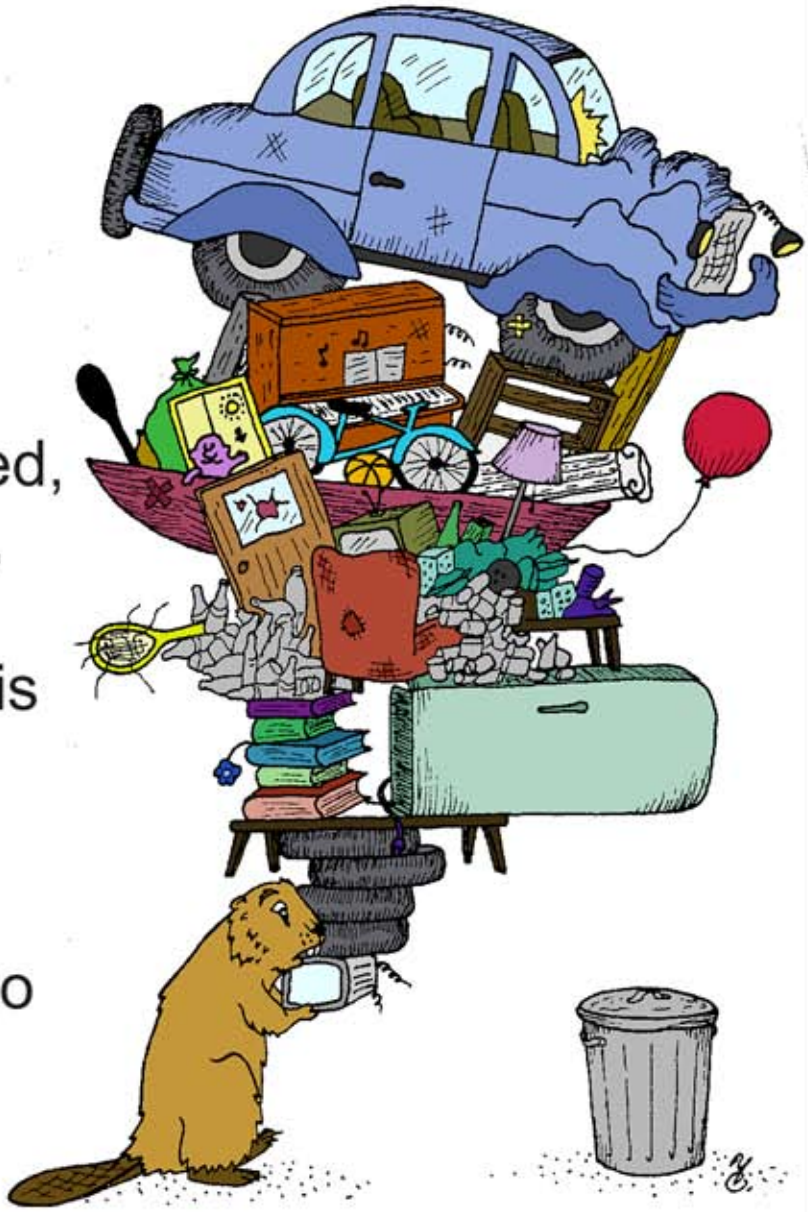
When used as a complement to the other steps of the waste management hierarchy, disposal is a good method of holding materials that cannot be reduced, reused, recycled, or recovered. Placing waste in landfills is similar to freezing left-overs. There are times when extra food cannot be avoided and similarly there are wastes we cannot presently make use of. By carefully preparing and storing both, they can be kept safe until needed. However, there is a limit to the left-overs a freezer can hold. Similarly there is a ceiling to what the Earth can store.

Brewster Facts

1. We make too much waste.

2. Some waste cannot be reduced, reused, recycled, composted or recovered. This is garbage.

3. Garbage needs to be carefully put away.



4. Landfills can be safe places to put garbage. Putting garbage in landfills is called disposal.

Incredible Edible Landfill

OBJECTIVE: To construct a model landfill using edible materials.

MATERIALS: chocolate wafer crumbs or preformed pie crust, red licorice whips, graham cracker crumbs, instant chocolate pudding, instant vanilla pudding, peanuts, raisins, chocolate chips, coconut dyed green, HANDOUT: **Landfill Layout** (G11)

VOCABULARY: compacted soil, decomposed, garbage, gravel, impermeable liners, landfill, leachate, leachate collection pipes, waste

BACKGROUND:

Modern landfills are carefully engineered structures. While every landfill is slightly different they all share the same basic features. A landfill has to hold garbage in a safe manner. Compacted soil, impermeable liners, pipes and gravel are used to form a type of large bowl. Waste is placed in this bowl then covered with dirt. This continues until the landfill is full. A final layer of soil is added to seal the landfill then grass is grown.

By building an edible landfill the children will be able to understand how a landfill works.

PROCEDURE:

1. Assemble enough ingredients to make one Landfill Pie for every six students. Give the students the HANDOUT: **Landfill Layout** (G11).

2. Each team of six students will prepare the vanilla and chocolate instant puddings in separate bowls. Add the raisins, peanuts, and chocolate chips to the vanilla pudding (mixed garbage).

3. Either prepare a chocolate pie crust according to directions on the wafer crumbs box or purchase one already made. This is the clay liner, essential to contain the decomposed garbage.

4. Criss-cross the pie crust with licorice whips to represent the leachate collection pipes.

5. Pack the graham crumbs around and over the licorice, continuing up the sides. This is the sand and gravel layer.

6. Spread a thin layer of vanilla pudding (mixed garbage) alternating with a thin layer of chocolate pudding (covering layer of dirt). Continue until the pie is full.

7. Cover overall with green dyed coconut to represent the grass that is grown after closure.

8. Enjoy!

Incredible Edible Landfill (cont.)

EXTENSION:

1. Hold a contest to judge the best looking and best tasting edible landfill.

2. Build one edible landfill large enough for the entire class. Have it for dessert during Environment Week, Earth Day, etc.

3. Have the students build mini landfills to take home. Modelling clay, aquarium rocks and pieces of garbage bags are some suggested materials.

EVALUATION:

1. Ask the class if they liked doing the activity.

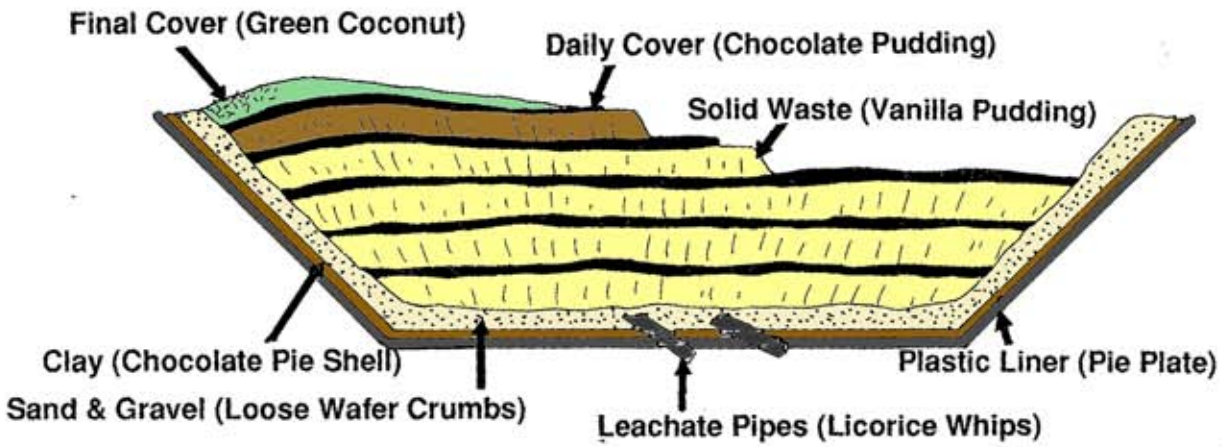
2. Ask the children to name two ingredients of their incredible edible landfills.

3. Were the students able to complete the activity?

Landfill Layout

- one package chocolate instant pudding
- one package vanilla instant pudding
- licorice whips
- coconut (dyed green)
- graham cracker crumbs
- wafer pie crust (chocolate)
- chocolate chips (optional)
- raisins (optional)

The puddings should be made before you start. Since the vanilla pudding represents the mixed garbage things like peanuts, raisins, chocolate chips or ju-jubes should be added. Once this is done you can go ahead and construct your landfill. The picture below may be of some help.



Which Waste Where?

OBJECTIVE: To teach the students how sorting waste can decrease the amount of waste they send for disposal.

MATERIALS: crayon or pencil, HANDOUT: **Mix& Match** (G15)

VOCABULARY: disposal, garbage, landfill, recovers, recycles, reduces, reuses, waste

BACKGROUND:

Not all waste should be sent for disposal. If a person reduces, reuses, recycles, composts and recovers their waste, only a small percentage will remain. This is garbage and is the only portion of waste that needs to be disposed of in a landfill.

Teaching children to sort waste helps the Earth in both the long and short terms. It teaches them to be responsible for the waste they produce today and makes them aware that what they throw away today could cause problems in the future.

PROCEDURE:

1. Discuss with the class, different options for handling their waste. Mention reduce, reuse, recycle, compost, recover and disposal.

2. Distribute the HANDOUT: **Mix & Match** (G15) to the class.

3. With a crayon or pencil the children are to draw a line from a garbage item to its most appropriate "waste place". The four choices are 1. Blue Box, 2. The Dump (landfill), 3. Reuse (Home), 4. Composter. As an example a line could be drawn from the picture of the apple core to the composter or a line drawn from the tire to the home to show that the tire could be reused as a swing or a planter.

4. Discuss the correct answers with the class after they have finished the exercise.

EXTENSION:

1. Have the children colour in the items on the HANDOUT: **Mix & Match** (G15).

2. Give the students four pieces of paper. One piece will represent a landfill, one a composter, one a Blue Box and the final piece a home (Reuse). On each piece of paper have them draw new items that can go in each "waste place".

Which Waste Where? (cont.)

EXTENSION (cont.)

3. Have the children take their corrected lists home for the whole family to use as a reference.

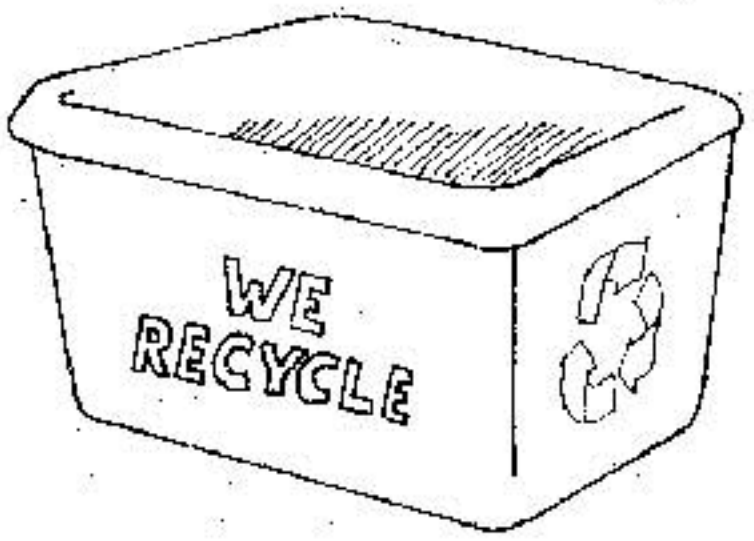
EVALUATION:

1. Ask the students to name all of the places for their waste.

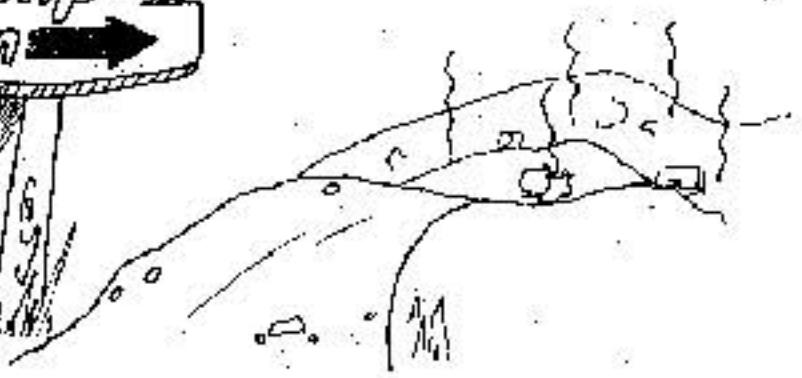
2. Do the children feel that landfills are needed and are not necessarily bad for the environment?

3. Ask the children to name two things that should be sent for disposal.

Mix & Match

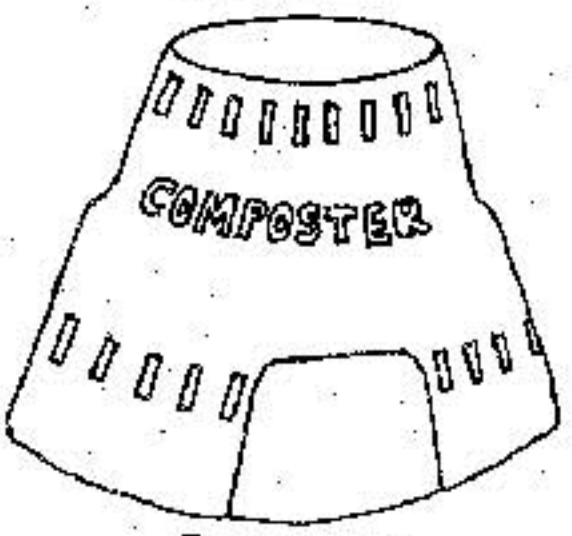


Blue Box

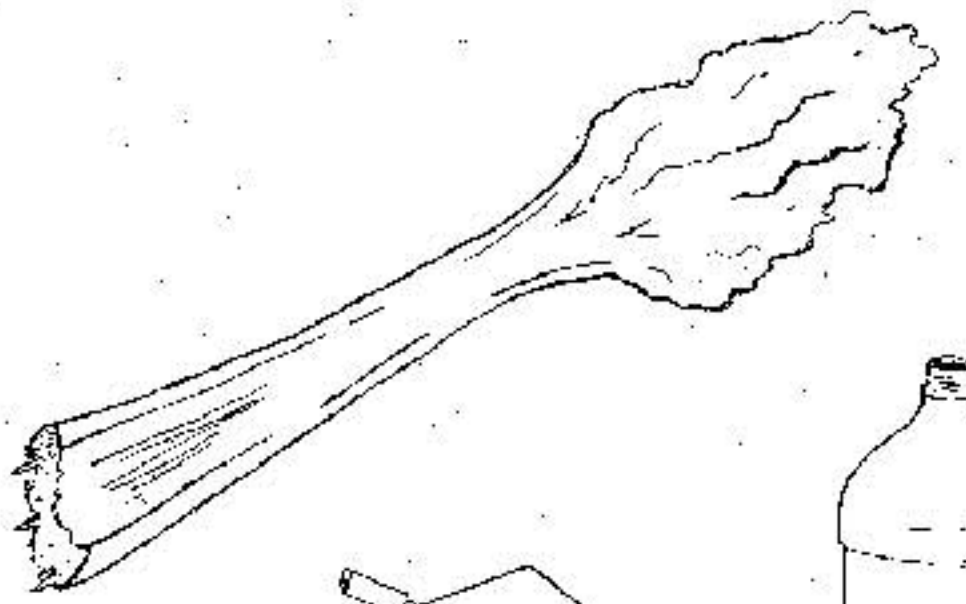


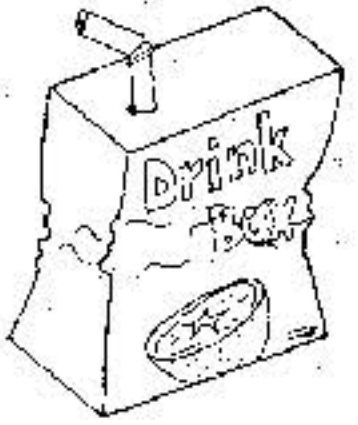
Landfill

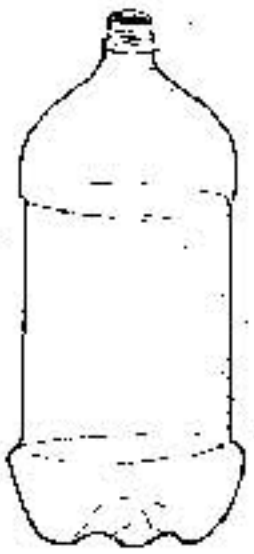
Reuse

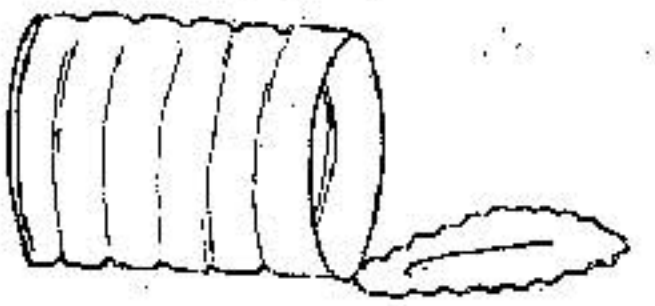


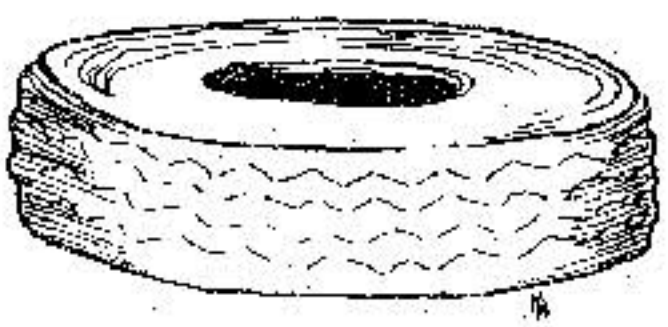
Composter











In this activity your job is to place the objects on this side of the page with one of the four choices on the left. Some of the objects can be placed in more than one spot so you must choose where you think is best.

Brewster Facts

1. Disposal is the final way of handling waste.

2. Only waste that cannot be reduced, reused, recycled, composted or recovered should be disposed.

3. Waste that cannot be handled by the 4 “R’s” or composting is garbage.

4. Garbage needs to be safely disposed to stop pollution.

5. The main problem with disposal is we use it too much. This causes landfills to fill up.

6. It is hard to find new landfills so we should dispose only when necessary.

The Code Word

OBJECTIVE: To familiarize students with some disposal terminology.

MATERIALS: pen or pencil, HANDOUT: **Picture This** (G21), HANDOUT ANSWERS: **Picture This Answers** (G22)

VOCABULARY: disposal, jargon, landfill, waste management,

BACKGROUND:

The key to understanding a subject is to understand the terminology special to that subject; waste management is no different. People are able to comprehend how reduction, reuse, recycling, composting and recovery can reduce the amount of waste going for disposal, in our landfills, when they understand the proper lexicon. Only a small percentage of our total waste needs to be buried in landfills. It is important for people to realize only the materials that cannot be handled by the 4R's and compost need to be disposed. This activity will teach the children to consider what they throw away and provide them with a fun way to learn new terms.

PROCEDURE:

1. Repeat the terms given in the ECOTALK (G39-40) of this chapter and emphasize the jargon that is used in the activity. Distribute the HANDOUT: **Picture This** (G21) to the class.

2. Work with the class as a whole on the example pictogram so that they understand how to interpret clues. Tell them the clues don't necessarily spell out the word letter by letter. Sometimes a picture represents merely the sound a letter combination makes. Allow the class time to work alone or in small groups to decipher the rest of the clues.

3. Take up the answers with the class and give them a quick definition for each word as it applies to disposal.

EXTENSION:

1. Have the class divide into small groups to decipher the clues. See which group finishes first.

2. Have the children make up their own pictograms and exchange them with other classmates.

3. Have the class colour or paint their own pictograms and exchange them with other classmates for them to solve**.**

The Code Word (cont.)

EVALUATION:

1. Were the children able to use their language skills and imagination to solve the pictograms?
2. Does the class think that the amount of garbage going to the landfills needs to be cut down.
3. What can be done at home or at school to cut down of garbage going to the landfill?

Picture This

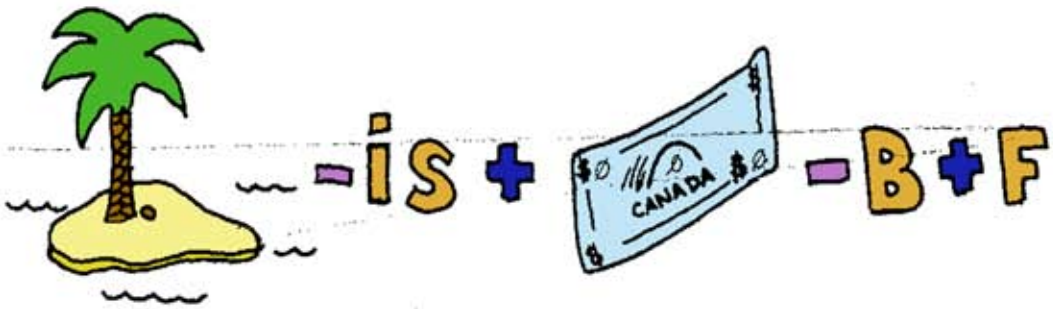
Try and solve the pictograms on the page below. All the words can be found in the Ecotalk of this chapter. The example given may be of some help. Have fun!

EXAMPLE

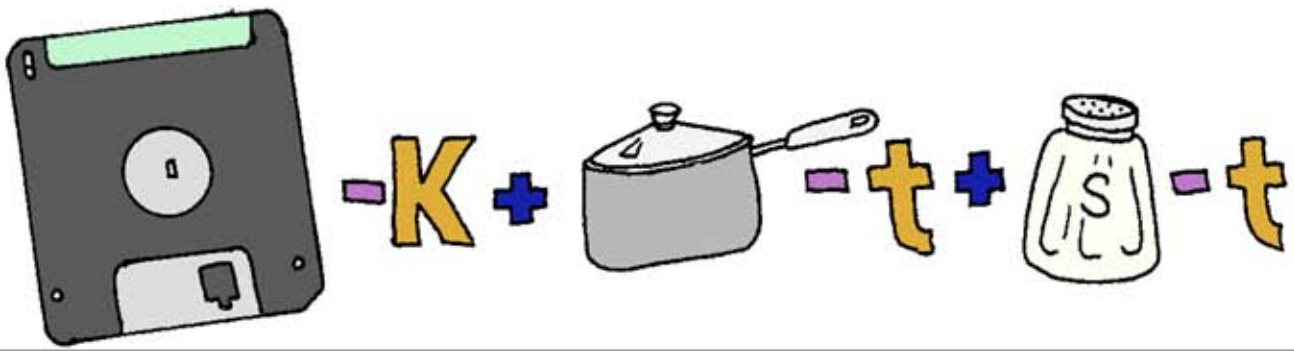
= JARGON

1.

2.



3.



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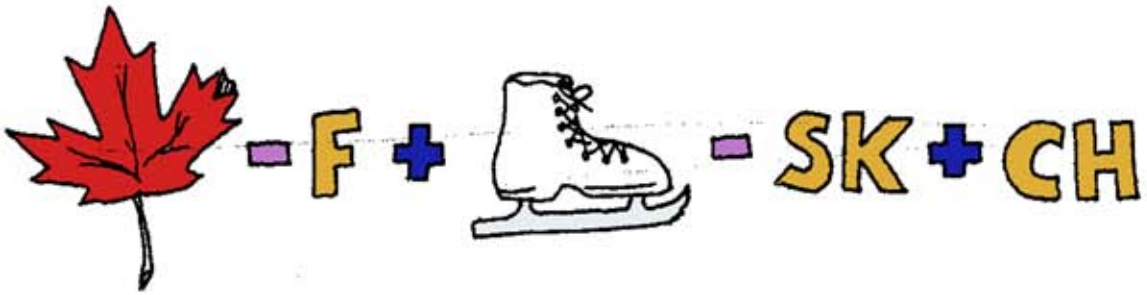


DISPOSAL - JUNIOR HANDOUT

Picture This Answers

EXAMPLE **Jargon**	1. **Blue Box**
2. **Landfill**	
3. **Disposal**	
4. **Leachate**	

Leachate Model

OBJECTIVE: To demonstrate the hazards landfills can cause to water supplies.

MATERIALS: non-hazardous garbage, clear glass jar, pantyhose, sieve/colander, bucket, water, pen/pencil and paper, HANDOUT: **Mock Muck** (G25)

VOCABULARY: chemicals, groundwater, hazards, heavy metals, landfill, leachate, leachate collection system, percolate, pesticides, pollution, precipitation

BACKGROUND:

One of the biggest fears associated with landfills is water pollution. People worry rain, snow and other forms of precipitation will pass downward through a landfill, picking up heavy metals, chemicals and other hazards. This polluted water continues downward until it reaches the groundwater. Liquid produced by landfills is called leachate.

Properly engineered landfills have leachate collection systems and liners to stop liquid from seeping into groundwater. The experiment in this activity will illustrate why these features are important.

PROCEDURE:

1. Review the BACKGROUND section of this activity with the class. Ask the children to think of things buried in a landfill that might cause water pollution.

2. Have the class bring garbage to school. Each student should also bring a clear glass jar. For safety reasons the garbage should only be non-hazardous materials. Fruit juice crystals, construction paper, pudding, old tea bags, used coffee grounds, mashed potatoes, creamed corn and ice cream are some suggested garbage ingredients.

3. Stretch a pair of pantyhose over the outside of a sieve or colander. Place the sieve/colander over a bucket.

4. Add the garbage to the sieve/colander. Slowly pour water over the garbage.

5. Wait for the water to percolate through the garbage then add more water. Repeat this process until approx. 1 to 1.5 litres of water is captured in the bottom of the bucket.

6. Pour a little of the water from the bucket into each child's glass jar. Have the class write a description of the water in the jars.

Leachate Model (cont.)

PROCEDURE (cont.)

7. Ask the children if they would like to drink the water. Ask them what they think would happen to someone who did drink it. Tell the class to imagine what the water would be like if the garbage in the sieve/colander contains pesticides, chemicals, bleach and other hazardous items.

8. Finally, explain that the liquid made from water flowing through garbage is called leachate. Without properly designed landfills leachate can end up in the water we drink.

EXTENSION:

1. Repeat the activity using a plastic bag to line the sieve/colander. This will show how the liner in a landfill helps stop leachate from escaping.

2. Visit the local landfill to see how leachate is controlled.

3. Find out what happens to leachate collected from your local landfill.

EVALUATION:

1. Ask the children why leachate needs to be controlled.

2. Will the children be careful about what they send to the landfill?

3. What are some things that their schools or homes may be sending to the landfills that could go elsewhere in order to cut down on the use of landfills (i.e. tea bags go to composters)?

Mock Muck

Using the garbage that the children brought from home, place it in the nylon covered sieve or colander. Pour a pitcher of water over the garbage and use a bucket to catch the strained water. The resulting water is called leachate.

Brewster Facts

1. Three quarters of our waste is sent for disposal. This figure is higher than it should be because people are disposing of useful materials instead of using the "4R's" and composting.

2. Disposal should be used to handle only material that cannot be reduced, reused, recycled, recovered or composted. Only useless waste, which is called garbage, should be disposed of.

3. If we are not careful with garbage it can create air, water and soil pollution. Disposal stores garbage in a safe and organized way.

4. Some garbage is treated prior to disposal. Burning, shredding and compressing garbage are some pre-disposal treatments.

5. Most garbage is placed in landfills. Landfills are like big suitcases. They only hold so much stuff. Disposing of useful waste is like overloading a suitcase. The case will not work properly or close if it is too full.

6. Because landfills are difficult to find it is important to use disposal only when we think there is no other choice.

Down Under

OBJECTIVE: The students will build their own landfill model.

MATERIALS: aquariums, clay or potting soil, coloured plastic garbage bag, coarse gravel, sand or aquarium rocks, straws, shredded construction paper, waxed paper, dirt from a vacuum, pieces of styrofoam, green shredded coconut, HANDOUT: **The Model Landfill** (G31)

VOCABULARY: bedrock, contamination, groundwater, landfill, leachate, methane gas, pollution

BACKGROUND:

All landfills must have some level of engineering to meet the Ministry of Environment and Energy's groundwater contamination and discharge limits. These limits help reduce water pollution. Engineering can also reduce pest and odour problems while improving the aesthetics of a landfill as well. Carefully designed landfills also control the potentially dangerous gases produced by rotting garbage.

While each landfill is designed especially for its geographic location and the waste it is to contain, most landfills have the following features: a bedrock or compacted soil base to stop leachate from reaching groundwater supplies, an impermeable membrane liner to stop water from escaping out of the landfill, a series of leachate collection pipes placed in a gravel layer to remove moisture from the landfill, small cells of waste covered daily with dirt to stop pest, odour and litter problems, methane gas monitoring wells and groundwater monitoring wells and a final cover of dirt and grass to stop pests and moisture from getting at the buried waste. A more detailed explanation of landfill technology and types can be found on the BACKGROUND INFORMATION pages (G1-G6) of this chapter.

This activity will provide the students with a better understanding of what a landfill is and how it works.

PROCEDURE:

1. Distribute the HANDOUTS: **The Model Landfill** (G31) and **Landfill Instruction** (G32) to the class.

2. Explain the function of each item on the HANDOUT (G31) to the students. Have the class take notes.

3. Divide the class into groups then assign each group an empty aquarium. Tell them to follow the instructions and diagrams on the HANDOUTS.

EXTENSION:

1. Have the groups do a small essay or bristol board display explaining the purpose of each part of the landfill. The BACKGROUND INFORMATION pages (G1-G6) will provide the information the students need.

Down Under (cont.)

EXTENSION (cont.)

2. Visit the local landfill to see how a real facility operates.

3. Find out if the local landfill has the same features as the models.

EVALUATION:

1. Ask each student to write or recite why landfills must be carefully engineered.

2. Do the students feel differently about disposing of useful waste (i.e. recyclable or reusable items) after building their models?

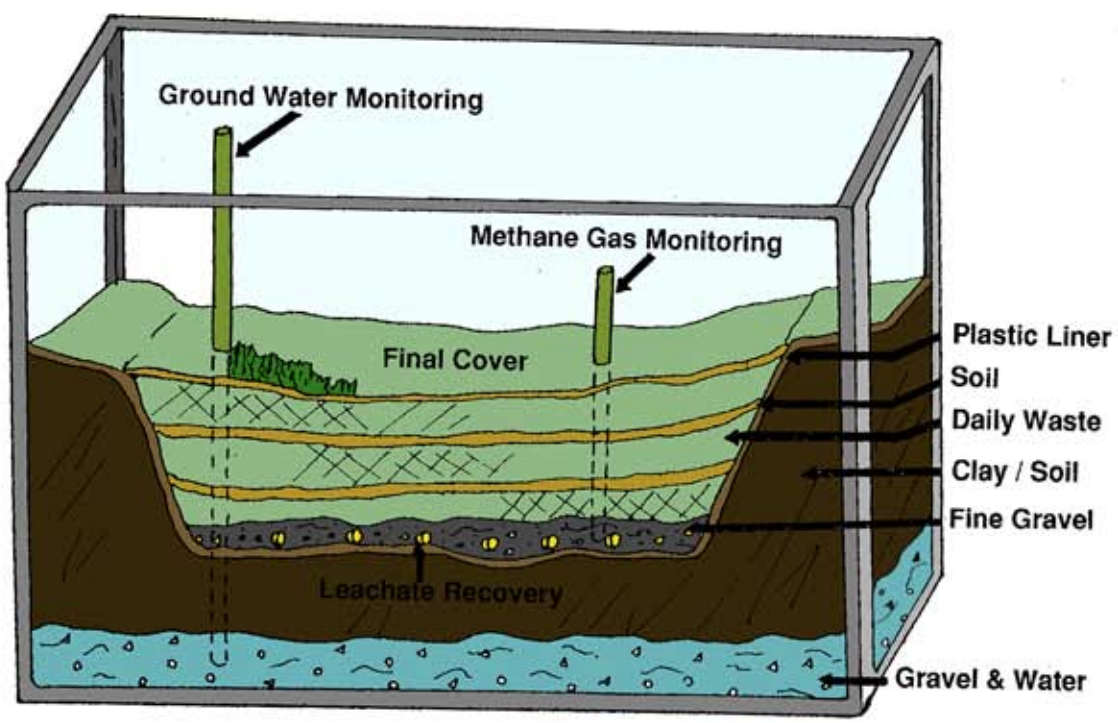
3. Do the students work well and co-operate as a team?

The Model Landfill

Materials:

- Aquarium
- Straws (Leachate Recovery & Monitoring Pipes)
- Garbage Bag (Plastic Liner)
- Clay or Potting Soil
- Coarse Gravel
- Fine Gravel
- Sand or Aquarium Rocks
- Construction Paper
- Waxed Paper
- Dirt
- Green Coconut

When the model is complete, finishing touches can be added by placing people, vehicles, signs and other miniatures on the surface.



DISPOSAL - INTERMEDIATE HANDOUT

Landfill Instructions

1. First place approximately 10 cm of gravel in the bottom of the aquarium. Add water until it covers half (5 cm) of the gravel. Place a straw long enough to reach to the top of the aquarium vertically in the gravel.

2. Add enough clay, potting soil or similar material to fill approximately half of the aquarium. Push the soil away from the middle of the aquarium to form a flat bottomed "V" shape in the soil. See HANDOUT (G31).

3. Gently compact the clay/potting soil.

4. Use a brightly coloured plastic garbage bag to line the "V". Trim the plastic so it does not extend out of the "V" or up the sides of the aquarium.

5. Place fine gravel, sand or coloured aquarium rocks on top of the liner. Lay several straws above the fine gravel etc. The straws should touch the aquarium glass at a right angle so they can be seen. Add more fine gravel, etc. so the straws are covered.

6. Now the landfill is ready for "waste". Place a few centimetres of shredded construction paper, bits of waxed paper, dirt from a vacuum and pieces of styrofoam in the "V". Cover the waste with a thin layer of soil. Repeat this process until the "V" is full.

7. Take a straw and place it into the waste. This will represent the methane gas monitoring equipment.

8. Sprinkle coconut dyed green on the last layer of soil covering the waste. This represents grass.

9. Attach labels and arrows to the outside of the aquarium to identify the elements of the landfill. Add small figures, vehicles, signs and roads to finish the landfill, if so desired.

Landfill Location

OBJECTIVE: To illustrate the difficulty associated with locating a landfill.

MATERIALS: pencil, coloured pencils, compass, HANDOUTS: **Bluewater County** (G35), **Landfill Location Factors** (G37), HANDOUT ANSWERS: **X Marks The Spot** (G36)

VOCABULARY: conservation areas, landfill, quarries, wetlands

BACKGROUND:

Careful consideration must be given to the location of a landfill. Road access, soil conditions, bodies of water, airports, built-up areas and other features such as wetlands, quarries and conservation areas are just a few of the considerations. The Ministry of Environment and Energy has a set of criteria to help establish the ideal location for a landfill. This activity will use a simplified number of factors to allow the students to decide where a new landfill should be located in a fictitious county.

The main purpose of this exercise is to have the students weigh different factors before making an informed decision. They should also realize that because new landfills are so difficult to locate that we need to stop present landfills from filling up too quickly. This can be achieved by reducing the amount of material being sent to landfills which in turn can be accomplished by practising the 4R's and composting.

PROCEDURE:

1. Tell the class they are going to compete against one another. Explain that either as groups or individuals they are going to see who can find the best location for a landfill.

2. Distribute the HANDOUTS: **Bluewater County** (G35) and **Landfill Location Factors** (G37). Have the students read both HANDOUTS.

3. Using a compass the students should draw the appropriate "rings of exclusion" around built-up areas, churches, schools, hospitals and airports on the HANDOUT: **Bluewater County** (G35). The rings should be shaded or coloured to represent areas where the landfill cannot be located.

4. Now the class should use a green pencil crayon to colour marshlands, wetlands or forests found on the maps.

5. Each student or group should draw a "buffer zone" of approximately 1/2 km along the shores of lakes and rivers.

Landfill Location (cont.)

PROCEDURE (cont.)

6. The paved roads in Bluewater County are to be coloured red.

7. The different types of soils found in the county should be identified with colour or shading on the students' maps.

8. After steps 3 to 7 of the PROCEDURE have been completed have each group of students decide where the best location for Bluewater County's landfill. A red "X" should be used to mark the location. (NOTE: There are two possible locations for the landfill).

9. Show the class the possible locations of the landfill on HANDOUT: **X Marks The Spot** (G36).

EXTENSION:

1. Have the students write a small essay explaining why they chose their landfill location.

2. Combine this activity with both the **Leachate Model** (G23) and **Down Under** (G29) to produce a science project on landfills.

3. Hold a debate in class. Divide the class into three groups: one group wants a new landfill in Bluewater County, one group does not and the third group is Bluewater Council who have to decide what to do.

EVALUATION:

1. Were the students able to make an educated decision on the location of the landfill?

2. Do the students understand the complexity of locating a landfill?

3. Will the students make an effort to divert waste form being sent to their local landfill?

Ecotalk

BEDROCK - the solid rock beneath the Earth's soils

BLUE BOX - a plastic box used to hold recyclable items.

CHEMICALS - are very complex. Some chemicals are natural and others are made by people. The most important thing to remember about chemicals is some chemicals are good but some can harm people and the environment.

COMPACTED SOIL - is soil that has been pressed down. Compact soils do not let water flow through as easily as non-compacted soil.

CONSERVATION AREA - a piece of land that is left in a natural state. Conservation areas usually have plants, trees, and animals. These things cannot be harmed in a conservation area.

CONTAMINATION - unwanted things found in something. Chemicals can be contamination water.

DECOMPOSED - when something has rotted. Compost is waste that has decomposed.

DISPOSAL - to get rid of something.

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

GRAVEL - is made from pieces of broken rocks. Gravel lets water through.

GROUNDWATER - is water that is underground. Wells are filled with groundwater.

HAZARDS - things that are dangerous. Broken glass is a hazard. Pollution is a hazard also.

HEAVY METALS - are metals such as lead, mercury, tin and silver. Heavy metals are dangerous to people who breath or eat them. People sometimes eat heavy metals by eating animals that have eaten plants full of heavy metals.

IMPERMEABLE LINERS - do not let water or other things through them. Impermeable liners are used to stop landfills from polluting water supplies.

JARGON - is words that are special to something. Hardware and software are computer jargon. P.D.day is teacher jargon.

LANDFILL(S) - a pit or hole in the ground used to hold garbage.

LEACHATE - is a liquid that forms when water passes through waste. The water dissolves some of the waste. Leachate can be dangerous if it contains hazardous waste.

Ecotalk (cont.)

LEACHATE COLLECTION PIPES/SYSTEM - a good landfill has pipes above the impermeable liner. These pipes are part of a system used to remove leachate from the landfill.

METHANE GAS- a colourless, odourless, gas. Methane is produced in landfills by rotting waste. It ignites easily and burns.

PERCOLATE - to flow through something. Water percolates through coffee in a coffee machine.

PESTICIDES- a chemical used to kill pests such as rats or termites.

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

PRECIPITATION - rain, snow, hail or other water that falls from the sky.

QUARRIES - a pit or other area where rocks are cut or blasted.

RECOVER(S) - is the fourth "R". Recover allows is to remove energy and resources from waste. An Energy-From-Waste plant recovers energy by burning waste.

RECYCLE(S) - 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 steal containers can be recycled to make new steel containers. A child recycles his old soft drink can.

REDUCE(S) - is the first "R". Reduce is easy, all you have to do is not make any waste or as little waste as possible. A person reduces waste to help the Earth.

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

WETLANDS - wet, swampy areas.

Glossary

AEROBIC: the utilization of bacteria with oxygen to reduce the volume of waste.

ANAEROBIC: the utilization of bacteria in the absence of oxygen to reduce the volume of waste.

AUTOCLAVE: an apparatus, using pressurized steam, for sterilization.

BALED: the compaction of material into a bundle to ease handling and reduce volume.

.

BIODEGRADABLE: a substance capable of natural decomposition into harmless elements, in a relatively short time.

BIOLOGICAL OXYGEN DEMAND (BOD): a measure of the amount of dissolved oxygen required for bacterial decomposition of organic wastes in water.

BIOMEDICAL WASTE: any part of the human body, including tissues and bodily fluids and non-anatomical waste infected with communicable diseases.

CHEMICAL OXYGEN DEMAND (COD): a measure of the amount of dissolved oxygen depleted by chemical reactions of pollutants in water.

COMBUSTION: the process of burning in the presence of oxygen, producing heat and light.

CORROSIVE: the ability to eat away at the surface of a substance (e.g. acids are corrosive to human tissue); a material that has this ability.

ENERGY FROM WASTE: the recovery of energy, from waste or refuse-derived-fuel, by pyrolysis or any other means of combustion.

ENVIRONMENTAL HEARINGS: the bureaucratic process, governed under the Environmental Assessment Act, consisting of meetings, involving governmental agencies, private contractors, and the general public, to determine the environmental impact of a proposed activity.

FLAMMABLE: the ability to catch fire and explode and burn readily at room temperature; a material that has this ability.

HARDNESS: the concentration of salts: calcium, magnesium, iron, in water that reacts with soap to produce a curd-like precipitate before a lather is formed. This can also produce a hard scale.

HAZARDOUS WASTE: material dangerous to human health and/or the environment. It includes toxic, corrosive, flammable, reactive and radioactive waste from homes, industry and agriculture.

IMPERMEABLE: not permitting water or other fluid to pass through.

Glossary (cont.)

INCINERATOR: as it relates to solid waste, the use of an enclosed device, utilizing controlled flame combustion, to reduce the volume of waste.

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

MONOFILL: a type of landfill devoted to only one type of waste.

PACKER TRUCK: a collection vehicle that compacts the material to reduce its volume.

PATHOGEN: an organism that produces disease, a bacteria or virus.

PERCOLATES: the process by which liquid passes through small spaces of a porous substance (i.e. precipitation passing through the waste in a landfill to form leachate).

RADIOACTIVE: material that gives off radiation as a result of decaying nuclei or a nuclear reaction.

REACTIVE: the ability to vigorously polymerize, decompose or condense, become self-reactive under shock or increases in temperature or pressure, or release a poisonous gas when contacted with water; a material with this ability.

TIPPING FEE: a charge for handling a given amount of waste, to cover disposal costs, including operation, and perpetual care. It is usually based on weight.

TOXIC: materials that, even in small quantities are poisonous or lethal.

WASTE MANAGEMENT MASTER PLAN: a long term study and proposal for dealing with waste. It includes analysis of present and future needs and facilities, in a given area.

Resources

1. Bluewater Recycling Association
   P.O. Box 1330
   Grand Bend, Ontario
   N0M 1T0
   Phone: (519) 238-8661
   Fax: (519) 238-2330

2. Ministry of Environment and Energy
   135 St. Clair Avenue West
   Toronto, Ontario
   M4V 1P5
   Phone: (416) 323-4321
   Fax: (416) 323-4643

3. Recycling Council of Ontario
   489 College Strre, Suite 504
   Toronto, Ontario
   M6G 1A5
   Phone: (416) 960-1025
   (800) 263-2849
   Fax: (416) 960-8053

4. Huron County Planning &
   Development Department
   Courthouse Square
   Goderich, Ontario
   N7A 1M2
   Phone: (519) 524-2188
   Fax: (519) 524-5677

5. Laidlaw Environmental Services Limited
   3221 North Service Road
   Burlington, Ontario
   L7R 3Y8
   Phone: (416) 336-1800
   Fax: (416) 336-0670

Videos

Unless specified all videos listed are available for use through the Bluewater Recycling Association.

Refuse Industry Productions, Garbage in America: Vol. I-III.

Speakers

1. The Bluewater Recycling Association
   P.O. Box 1330
   Grand Bend, Ontario
   N0M 1T0
   Phone: (519) 238-8661
   (800) 265-9799
   Fax: (519) 238-2330

2. The Recycling Council of Ontario
   489 College Street, Suite 504
   Toronto, Ontario
   M6G 1A5
   Phone: (416) 960-1025
   (800) 263-2849
   Fax: (416) 960-8053

Resources (cont.)

Speakers (cont.)

3. Ministry of Environment and Energy
   135 St. Clair Ave West
   Toronto, Ontario
   M4V 1P5
   Phone: (416) 323-4321
   Fax: (416) 323-4643

4. Global Action Plan (G.A.P.)
   R.R.#4, 6080 Durham Road 23
   Uxbridge, Ontario
   L4P 1K4
   Phone: (416) 852-4786
   Fax: (416) 852-4786

5. Loblaws Inc.
   22 St. Clair Ave. East, 9th Floor
   Toronto, Ontario
   M4T 2S8
   Phone: (416) 922-8500
   Fax: (416) 960-6998

6. Federation of Ontario Naturalists
   355 Lesmill Rd.
   Don Mills, Ontario
   M3B 2W8
   Phone: (416) 444-8419
   Fax: (416) 444-9866

7. Laidlaw Environmental Services Limited
   3221 North Service Road
   Burlington, Ontario
   L7R 3Y8
   Phone: (416) 336-1800
   Fax: (416) 336-0670

8. Pollution Probe
   12 Madison Avenue
   Toronto, Ontario
   M5R 2S1
   Phone: (416) 926-1907
   Fax: (416) 926-1601

9. Metropolitan Toronto and Regional
   Conservation Authority
   Water Resources Branch
   5 Shoreham Dr.
   Downsview, Ontario
   M3N 1S4
   Phone: (416) 661-6600
   Fax: (416) 661-6898

10. Greenpeace
    185 Spadina Avenue, 6th Floor
    Toronto, Ontario
    M6G 1K1
    Phone: (416) 345-8408
    Fax: (416) 345-8422

End Notes

[1]Ministry of the Environment and Energy Regulation 347, Ministry of Government Services, Publications Ontario, 88 Bay Street, Toronto, Ontario N7A 1N8, 1-800-668-9938.

To order copies of discussion papers published by the Ministry of the Environment and Energy, call the automated phone line at 1-800-268-3747, and ask for area code 416 and phone number 323-4643.

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