

SOLID WASTE MANAGEMENT PROGRAMME

START.MANAGING.ALL.RESOURCE.S.TODAY

SMART Ranger Modules

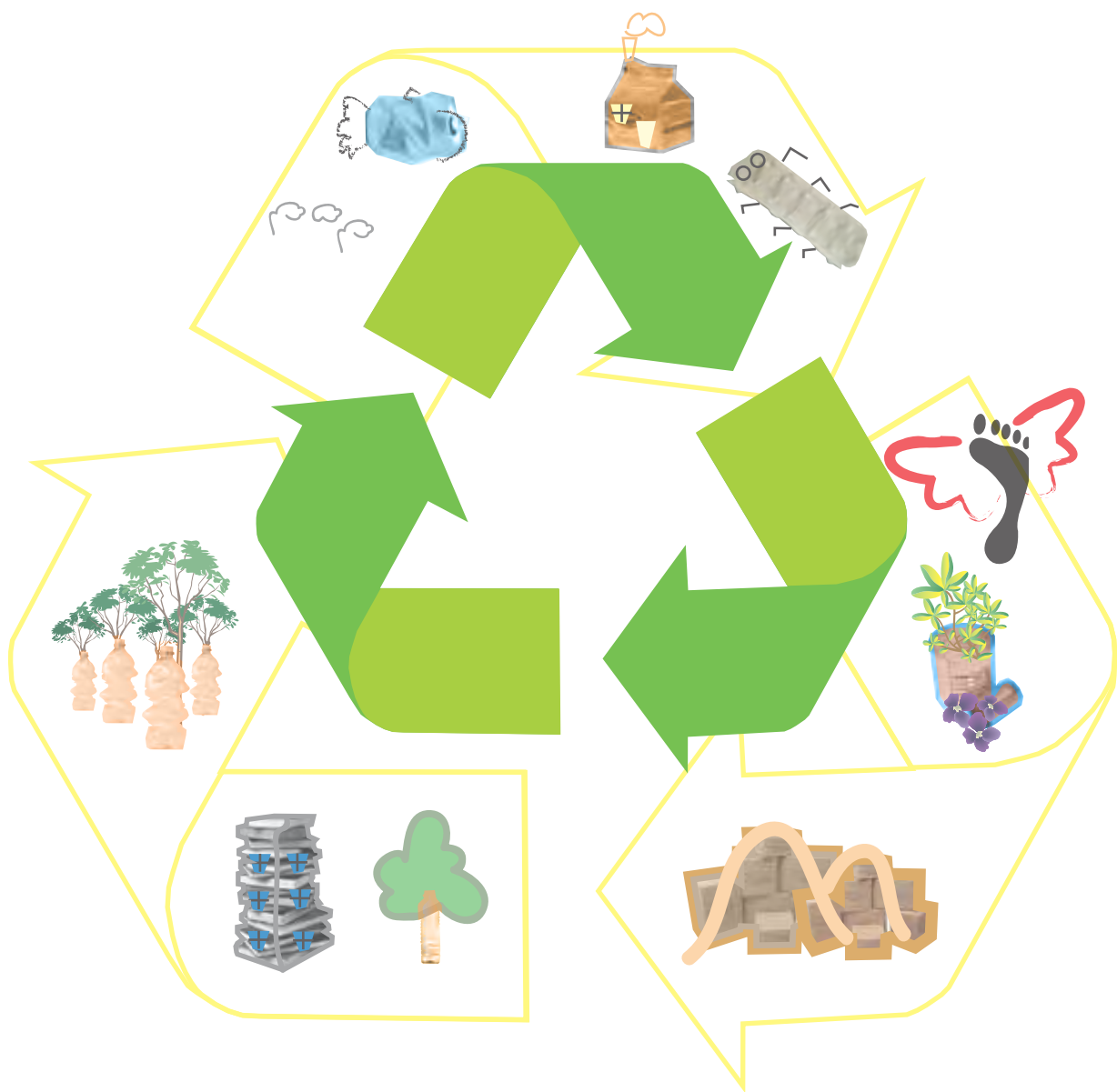


rethink.reduce.reuse.recycle.compost.close the loop

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SMART Ranger Modules



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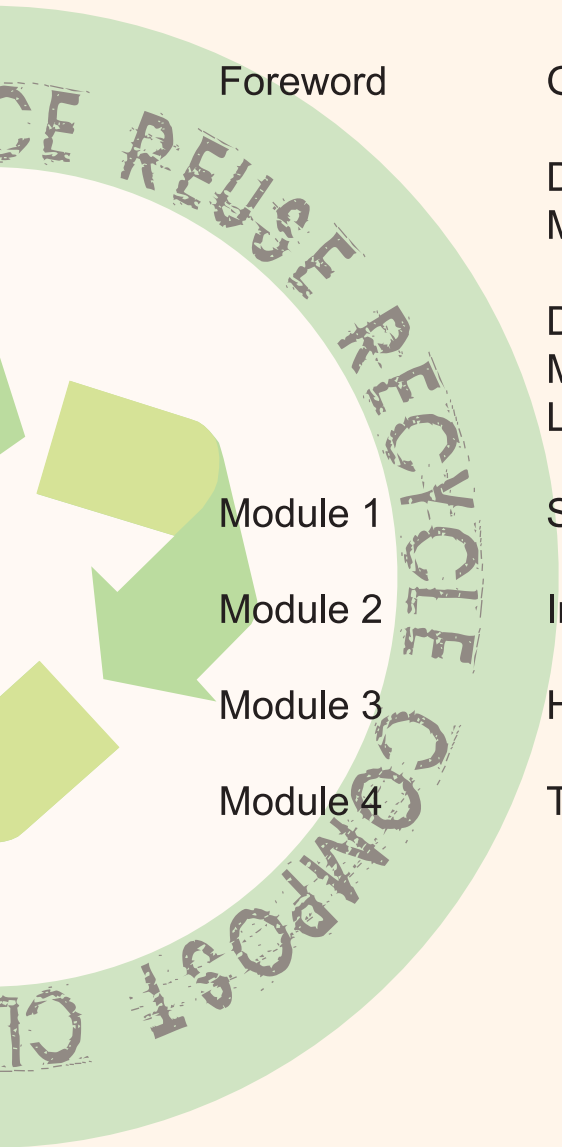
Designed and illustrated by

Shafinaz Shahabudin



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Foreword

Solid waste is one of the three major environmental problems in Malaysia. It plays a significant role in the ability of Nature to sustain life within its capacity. Currently, over 23,000 tonnes of waste is produced each day in Malaysia. The amount of waste generated continues to increase due to the increasing population and development, and it is estimated that less than 5% of the waste being recycled.

To address this issue, Global Environment Centre initiated a project, SMART Rangers (Start Managing All Resources Today) to train school communities on proper SWM (focused on addressing issues surrounding SWM and its connection to climate change). This is the first of its kind in Malaysia, and aims to demonstrate that simple community action can make a lasting difference in the current state of the environment. The project had enormous impact on managing solid wastes within schools, empowering them to make changes in their own lives by implementing SWM systems.

The basis of this project follows the concept of “Civic Science”, which was developed by GEC. It involves the process of enhancing awareness, providing knowledge and skills to proactively address environmental issues. The 4R 2C Concept (Rethink, Reduce, Reuse, Recycle, Compost and Close the loop), which advocates a zero waste system is used throughout the project.

The comprehensive modules that you will find in these modules were written with specific relevance to solid waste and resource management. Students that were involved in SMART Rangers begin to take conscious decisions and choices when disposing waste. The project thus creates opportunities and avenues for students to practice what they have learnt on a big scale that includes their schools and surrounding communities.

GEC would like to extend their heartfelt gratitude to DANIDA Solid Waste Management Component for the funding of SMART Rangers and the opportunity to share this knowledge with the ten schools that have participated in this project. It is sincerely hoped that the project will continue to be implemented in more schools in the future. Their funding has contributed to the publication of these modules, and we wish to thank them for their continuous support for this.

GEC would also like to thank Ministry of Education (MoE), National Solid Waste Management Department (JPSPN), Petaling Jaya City Council (MBPJ) and Gua Musang District Council (MDGM) for their continuous support, cooperation and participation in SMART Rangers. Their involvement and input for the development of these modules have been a key driving factor in this project.

Besides that, GEC also thanks the participating school teachers for their valuable input and ideas for the modules that were developed. Each module has been enriched by their involvement. It is our sincere hope that these modules will be fully utilized by schools and communities throughout the country in managing solid wastes productively.



Faizal Parish
Director
Global Environment Centre

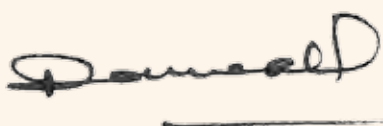
Foreword

The SMART Rangers initiated by Global Environment Centre has seen tremendous success in its projects with schools in Petaling Jaya and Gua Musang. The objectives of SMART Rangers incorporate educating school children and their communities on the importance of proper solid waste management systems, which is essential in these times.

MoE has always been supportive of projects initiated by GEC. We have seen positive feedback and changes in the participating schools. Students are able to understand the importance of managing their resources by applying the concepts advocated by GEC, mainly 4R 2C and Civic Science. The application of Civic Science to the daily lives of students makes a huge difference in their thinking and decision making process.

The SMART Rangers modules have played an important role in shaping students with higher environmental awareness and knowledge, especially in solid waste management and its effects on climate change. It is heartening to see students starting young in their quest to ‘green’ their schools. As such, we at MoE find that this book is a good tool for students and teachers alike to practice best management practices on solid waste.

On behalf of the Ministry of Education, I would like to congratulate GEC and DANIDA for their efforts and commitment to this project. It has reaped benefits beyond expectations. There has been a noted elevation in environmental consciousness of young students who were part of this project. MoE sincerely hopes to see more schools benefiting from the SMART Rangers in the near future.



Jame Alip ASDK.BSK.
Director
Division of Sports, Arts and Cocurriculum,
Ministry of Education

Foreword

Department of National Solid Waste Management (JPSPN) strongly believes in constantly upgrading the quality of solid waste management of the country. While the Department works persistently at higher levels, working at the grassroots is equally important.

The SMART Rangers modules serve this very purpose. They address issues and concerns surrounding solid waste management, involving a target audience that will make the most difference – members of school community.

Each module has been carefully designed and molded to highlight issues concerning solid waste management and the management of resources. One good example is highlighting the art of recycling, composting and garbage enzymes – all of which are important components of the best management practices for solid waste.

Solid waste management education is not just about learning how to manage waste; it is about a change in lifestyle. For us at JPSPN, this book clearly shows how to make that change.

JPSPN is also pleased that the production of this modules emphasizes on the sorting of waste at its source, which is an important element the new Solid Waste and Public Cleansing Management Act 2007. As the disposing and decomposition of solid waste contribute to climate change, it is only right to say that this book will play a key role in reducing the amount of waste that ends up in our landfills.

We, at JPSPN, are glad to be a part of this project, and we wish GEC all the best for their efforts to make a lasting difference for the benefit of our nation. We also thank DANIDA for their generous funding of this publication



Dato' Nadzri Bin Yahaya, Ph.D
Director General
Department of National Solid Waste Management
Ministry of Housing and Local Government

MODULE 1

SOLID WASTE AND THE ENVIRONMENT

1.1 THE ENVIRONMENT

LAND POLLUTION

WATER POLLUTION

AIR POLLUTION

1.2 INTRODUCTION TO SOLID WASTE

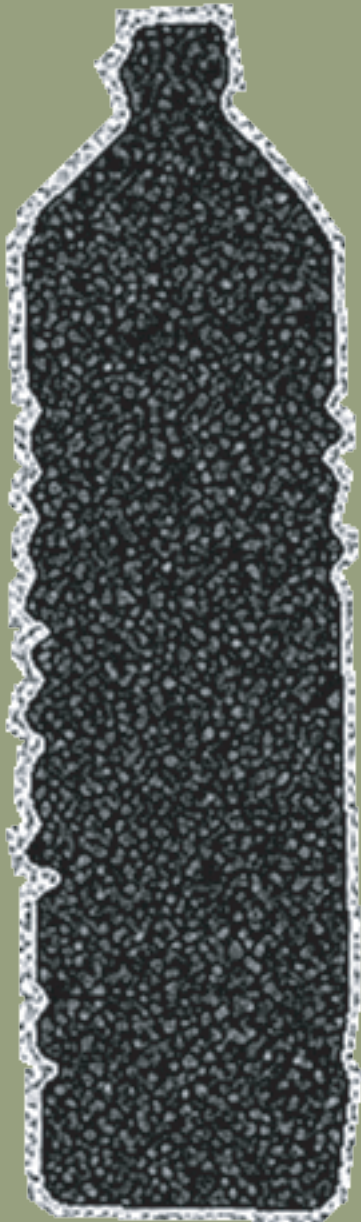
SOLID WASTE DEFINITION

TYPES OF WASTE

SOURCE OF WASTE

WHAT ARE THE PROBLEMS
AND ISSUES RELATES TO
SOLID WASTE?

IMPACTS OF SOLID WASTE
ON OUR ENVIRONMENT



Chapter 1: Solid Waste and the Environment

1.1 The Environment

The natural environment comprises all naturally occurring surroundings and conditions in which living things grow and interact on Earth. These include complete landscape units that function as natural systems without major human intervention, as well as plants, animals, rocks, and natural phenomena occurring within their boundaries. They also include non-local or universal natural resources such as air, water and climate (Wikipedia, 2009).

Malaysia is among the twelve countries in the world that are blessed with a wealth of biodiversity. We have 15,000 flowering plants, 1,500 vertebrates and 150,000 invertebrates. No wonder Malaysia has been identified as one of the world's megadiversity hotspots. Tropical forests, the oldest and most biologically diverse ecosystem on earth, cover much of the country. Floristically, Malaysia is rich as there are over 15,000 species known to occur here. There are 286 species of mammals, 150,000 species of invertebrates, with insects being the largest single group, 1,200 species of butterflies, and 12,000 species of moths and over 8,000 species of fish (Latiff & Zakri, 2000).

Our environment is under attack. One of the factors that has led to this state of affairs is that there is neither sustainable management of the environment nor management integration which has given rise to all sorts of pollution that are harmful to the environment and us.

Pollution is defined as an act or process that induces the presence of unknown substances in the form of liquid, gas or solid. These unknown substances are able to cause changes in the quality of the surrounding environment which has a direct negative impact on it. Among natural causes of pollution are from flooding, earthquakes, tsunami, volcanic eruption and animal litter. Examples of pollution caused by humans are solid waste/garbage, industrial and agricultural waste, and sewage.

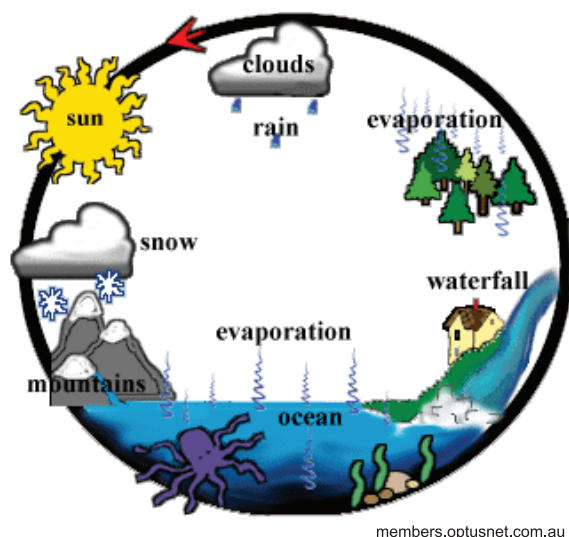
Pollution issues usually happen in the three main areas of environment- land, water and air.



1.1.1 Land Pollution

As defined by Wikipedia (2007), land pollution is the degradation of earth's land surfaces often caused by human activities and their misuse of land resources. Exploitation of minerals and improper use of soil by inadequate agricultural practices are some of the causes of land degradation and pollution. It is possible that land pollution caused by urban and industrial waste may also contaminate air and water. Waste being washed away into drains that lead to rivers; and toxic chemical waste not being disposed of properly cause toxic substances to seep into the ground and potentially contaminate water bodies. There is also a possibility that the toxic chemical released may produce toxic vapour, hence, contributing to air pollution.

1.1.2 Water Pollution



Water is essential to life. Without it, the biosphere that exists on the surface of the earth wouldn't be possible. Although 70% of the earth is covered with water, only a small percentage (around 0.3%) is freshwater that can be used for human purposes. The total amount of the earth's water does not change and it is repeatedly recycled through the hydrologic cycle, also known as the water cycle.

The water cycle is a natural process that collects, purifies and redistributes water, recycling all of our planet's water. Water moves up into the atmosphere by evaporation and back down to the earth's surface as precipitation. We rely on this system for our existence and we need to remember that it is highly sensitive to our activities and actions.

Water evaporates from the sea, lakes, reservoirs, rivers and streams (surface water) and rises into the atmosphere. As air hits the mountain side, it is forced upwards causing the water vapour to cool and condense, forming rain clouds. When clouds become heavy with liquid droplets (or ice particles in cold climates), rain (or snow) falls. The rain water will then flow over the land into rivers and streams. The sun provides energy for part of the water cycle, especially evaporation and transpiration (evaporation through the leaves). Some of the water that falls onto the land seeps through the soil and forms another store of water: groundwater.

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to all organisms including humans. Water pollution is a major global problem as water is important for survival and less than 3% of Earth contains water that is safe for drinking (Wikipedia, 2009).

Water has the capacity to dissolve or break down many substances, especially organic compounds, which decompose during continued contact with bacteria and enzymes. Such non-biodegradable elements remain in water and can make it poisonous for most forms of life. Even biodegradable pollutants can damage a water supply for long periods of time. Thereupon, life within the water begins to suffer. Lakes are especially vulnerable to pollution because they cannot cleanse themselves as rapidly as rivers or oceans.

Although a lot of factors are causing deterioration of the quality of rivers and lakes in Malaysia, industry, homes and farming are the main three contributors.

MODULE 1: SOLID WASTE AND THE ENVIRONMENT

a) So, how do we contaminate our freshwater supply?

i) Organic Waste



Most fresh water pollution is caused by the addition of organic material in water bodies which is mainly animal waste, human sewage, food waste or excessive soil deposits.

Allowing livestock to graze near water sources often results in organic waste products being washed into the waterways, while sewage generated by houses or runoff from septic tanks may flow into water sources.

This sudden introduction of organic material increases the amount of nitrogen in the water and leads to eutrophication.

Oxygen is normally present in high quantities in water bodies but when bacteria and other micro-organisms feed on organic matter in the water, large populations of them quickly develop and they use up much of the oxygen dissolved in the water, thus decreasing the level of oxygen in the water. Animals have different levels of tolerance to oxygen and are considered bioindicators which reveal the condition and quality of lakes and rivers.

ii) Pesticides and Fertilizer

Farms often use large amounts of herbicides and pesticides, both of which are toxic pollutants. These substances are particularly dangerous to life in rivers, streams and lakes, where toxic substances can build up over a period of time. Farms also frequently use large amounts of chemical fertilizers that are washed into the waterways and damage the water supply and the life within it. Fertilizers increase the amount of nitrates and phosphates in the water, which can lead to the process of eutrophication.

iii) Industrial Waste

Industries and agriculture come a close second, with toxic chemical by-products being dumped into our rivers. Chemical waste products from industrial processes are sometimes accidentally discharged into rivers. Examples of such pollutants include cyanide, zinc, lead, copper, cadmium and mercury. These substances may enter the water in such high concentrations that fish and other animals are killed immediately. Sometimes the pollutants enter a food chain and accumulate until they reach toxic levels, eventually killing birds, fish and mammals.



Industry often uses water for cooling processes, sometimes discharging large quantities of warm water back into rivers. This is a form of thermal pollution where raising the temperature of the water lowers the level of dissolved oxygen and upsets the balance of life in the water. This condition can kill fish and other aquatic organisms incapable of tolerating the high temperature.

Acid precipitation is caused when the burning of fossil fuels emits sulphur dioxide into the atmosphere. The sulphur dioxide reacts with the water in the atmosphere, creating rainfall which contains sulphuric acid. As acid precipitation falls into rivers, lakes and ponds it can lower the overall pH of the waterway, killing vital plant life, and thereby affecting the whole food chain. It can also leach heavy metals from the soil into the water, killing fish and other aquatic organisms. Because of this, air pollution is potentially one of the most threatening forms of pollution to aquatic ecosystems.

In mining and oil-drilling operations, corrosive acid wastes are poured into the water. Decaying tanks and cesspools, used where sewers are not available, may also pollute the groundwater and adjacent streams, sometimes with disease-causing organisms.

iv) Siltation and Sedimentation



Clearing of land for farming or any other development near riverbanks and water bodies can lead to erosion of soil into the rivers or lakes. The silting of streams is a kind of water contamination. A heavy load of silt kills fish indirectly by decreasing the quantity of oxygen and other nutrients in water. Then, as the flowing water slows, silt is deposited on streambeds. Reservoirs behind dams also will be filled with silt unless erosion is stopped in the watershed above. Sedimentation also taints water. It is the result of poor conservation practices. Sediment fills water supply reservoirs and fouls power turbines and irrigation pumps. It also diminishes the amount of sunlight that can penetrate the water. In the absence of sufficient sunlight, the aquatic plants that normally furnish the water with oxygen fail to grow.

MODULE 1: SOLID WASTE AND THE ENVIRONMENT

v) Solid Waste

Many waterways are utilized as dumps for household and industrial wastes. Some communities dump rubbish and untreated sewage into the nearest streams. Industries contaminate the waterways when they discharge acids, chemicals, greases, oils, and organic matter into them. They destroy commercial fisheries when they block the sunlight from coming through to the organisms. They also cause streams to become unusable for recreational purposes.



vi) Oil Pollution

If oil leaks enter a slow-moving river, it forms a rainbow-coloured film over the entire surface preventing oxygen from entering the water and cause suffocation and later lead to death of the animals there.

b) Effects And Impacts Of Water Pollution :

i) Effect on Lakes and Water Organisms

As mentioned previously, water pollution from different kinds of sources will eventually lead into water bodies. Since water ecosystems are fragile, the slightest change of temperature or condition will prove disastrous to the living organisms. For example, if oil leaks into rivers or lakes, the ecosystem will face dire consequences. Snails may lose their ability to attach themselves to a rock for stability, and be swept away and killed. Fish may ingest oil and depending on how the compounds react with their individual cells, clog their gills. Crustaceans and fish eggs may be affected by toxic materials found in even a thin layer of oil on the surface of the water. In contrast, if the oil sinks into the water's sandy sediment, or covers its beaches, some species (oysters, clams, mussels, smelt, and herring) may not generate offspring. If they do, the offspring may be affected.

ii) Effects on Human health

The effects will depend on the source of pollution itself because different sources have different impacts. Nitrates in drinking water can cause a disease in infants that sometimes results in death. Metals like lead (from batteries paint and petrol) and mercury (from batteries, plastics) can cause untold damage to the nervous system and brain functions. It can also have an effect on reproductive systems and organs. Crops can absorb cadmium in sludge-derived fertilizer; if ingested in adequate quantities, the metal can cause acute diarrhoea and liver and kidney damage.



1.1.3 Air pollution

Air pollution is the act of environmental contamination with man-made waste into the air. The air we breathe is composed of a mixture of gases: 78% nitrogen, 21% oxygen, and a small percentage of other gases like argon, carbon dioxide, and water vapour. Other air pollution may be so apparent that it surrounds us like smog, which is a cloud or haze of air pollution. How often have you seen smog hanging over the tall skyscrapers in urban areas? Why do you think cities are more likely to have smog than suburban or rural areas? Cities have a tendency to have a greater portion of industrialized areas. Industry is the main contributor to air pollution. Many times factories release greenhouse gases like carbon dioxide, chlorofluorocarbons (CFCs), methane, and nitrous oxide into the atmosphere (Kaufman and Franz). Greenhouse gases contribute to a phenomenon called the greenhouse effect or more simply put, global warming. These greenhouse gases trap heat within the atmosphere, thus raising the temperature of Earth.

Air pollution is defined as the contamination of the atmosphere by the discharge of harmful airborne substances.

While the sources of some air pollutants are natural, such as volcanic eruptions, much of air pollution is a result of human activities. The burning of fossil fuels for energy to run machinery, vehicles and generate electricity is the major source of air pollutants resulting from human activities. In urban areas, fossil fuel emissions of most concern include sulphur dioxide, nitrogen oxide, carbon monoxide and volatile organic compounds. Also, an estimated 500,000 tonnes of lead are released into the atmosphere through human activities each year, over half of which comes from vehicle exhausts.

Air pollution can seriously affect human health and also damage the environment and property. It can cause health problems such as burning eyes and nose, itchiness, throat irritations and breathing problems. Some chemicals found in polluted air can cause cancer, birth defects, brain and nerve damage, and long-term injury to the lungs and breathing passages in certain circumstances.

Air pollution has also led to the thinning of the protective ozone layer above the Earth, causing more harmful ultra-violet radiation to reach the Earth. Increased human exposure to these harmful radiation has resulted in an alarming increase in incidents of skin cancer throughout the world. Falling as “acid rain”, air pollution is killing lakes and forests. In developed countries, air pollution has destroyed thousands of lakes and millions of hectares of forests. In Sweden for example, fish have died out in 4,000 of the lakes in the country and another 18,000 face the same predicament. Acid rain also has a corrosive effect which can cause much damage to buildings and other physical structures.

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Most serious of all, a great majority of scientists now agree that air pollution is changing the climate by causing world temperatures to increase – the greenhouse effect or global warming. This has severe consequences for world climate and far reaching implications for food production in the new millennium.

In Malaysia, air pollution is a serious environmental problem. This is sometimes compounded by smoke from forest fires in Indonesia, which causes a severe haze that may envelop the entire country. A good example was the haze in 1997 which affected major parts of the country, when almost the entire population in the country had to take emergency measures to avoid developing respiratory problems. Thousands of people were admitted to hospitals with health problems related to the haze during the period. In Sarawak, schools had to be closed, and many businesses had to shut down on government order, in order to minimize the local sources of pollution. Visibility was also poor that many flights at the KL International Airport were affected. In recent years, the country has also experienced some of the effects of global warming; the El Nino phenomenon, extreme changes in weather patterns, severe rains and floods, and sometimes, long periods of droughts with high daily temperatures.

a) Types of Air Pollution

Air pollution can be divided into two types; indoor and outdoor pollution.

Indoor air pollution. This is caused by tobacco smoke, emissions from cooking and heating appliances and vapours from building materials, paints and furniture inside buildings. The problem is exacerbated when the buildings are poorly ventilated – causing some buildings to be called “sick” buildings. Such buildings are unfit for human occupation.

Outdoor air pollution. This is caused by pollutants derived from many sources, primarily automobile exhausts and industrial emissions.

b) Sources of Air Pollution

- i) Sulphur dioxide (SO₂).
- iii) Carbon monoxide (CO).
- iv) Nitrogen oxides (NO_x).
- v) Volatile Organic Compounds (VOCs).
- vii) Lead and Heavy Metals.
- viii) Halocarbons-Halocarbons such as chlorofluorocarbons (CFCs)
- x) Ozone

c) Effects of Air Pollution

i) Effects on Human Health

Every day, the average person inhales about 20,000 litres of air. Every time we breathe, we risk inhaling dangerous chemicals that have found their way into the air. Air pollution is responsible for major health effects. Older people are highly vulnerable to diseases induced by air pollution. Children, infants and those with heart or lung disorders are highly susceptible and more at risk of being exposed to air pollution. Some pollutants such as lead, mercury, particulate matter, carbon dioxide and ozone-forming nitrogen dioxides cause cancer, birth defects, brain and nerve damage and long-term injury to the lungs and breathing passages. Sulphur dioxide in ambient air affect particularly those suffering from asthma and chronic lung diseases. Low level ozone have serious effects on human health, including a number of morbidity and mortality risks associated with lung inflammation, as well as asthma and emphysema.

ii) Effects on the Environment

Acid rain causes acidification of lakes and streams, contributes to damage of forests and trees and corrodes physical infrastructures.

Global warming as a result of rising global temperatures caused by increased emissions of carbon dioxide and other greenhouse gases is expected to raise sea levels and cause extremes in climate patterns.

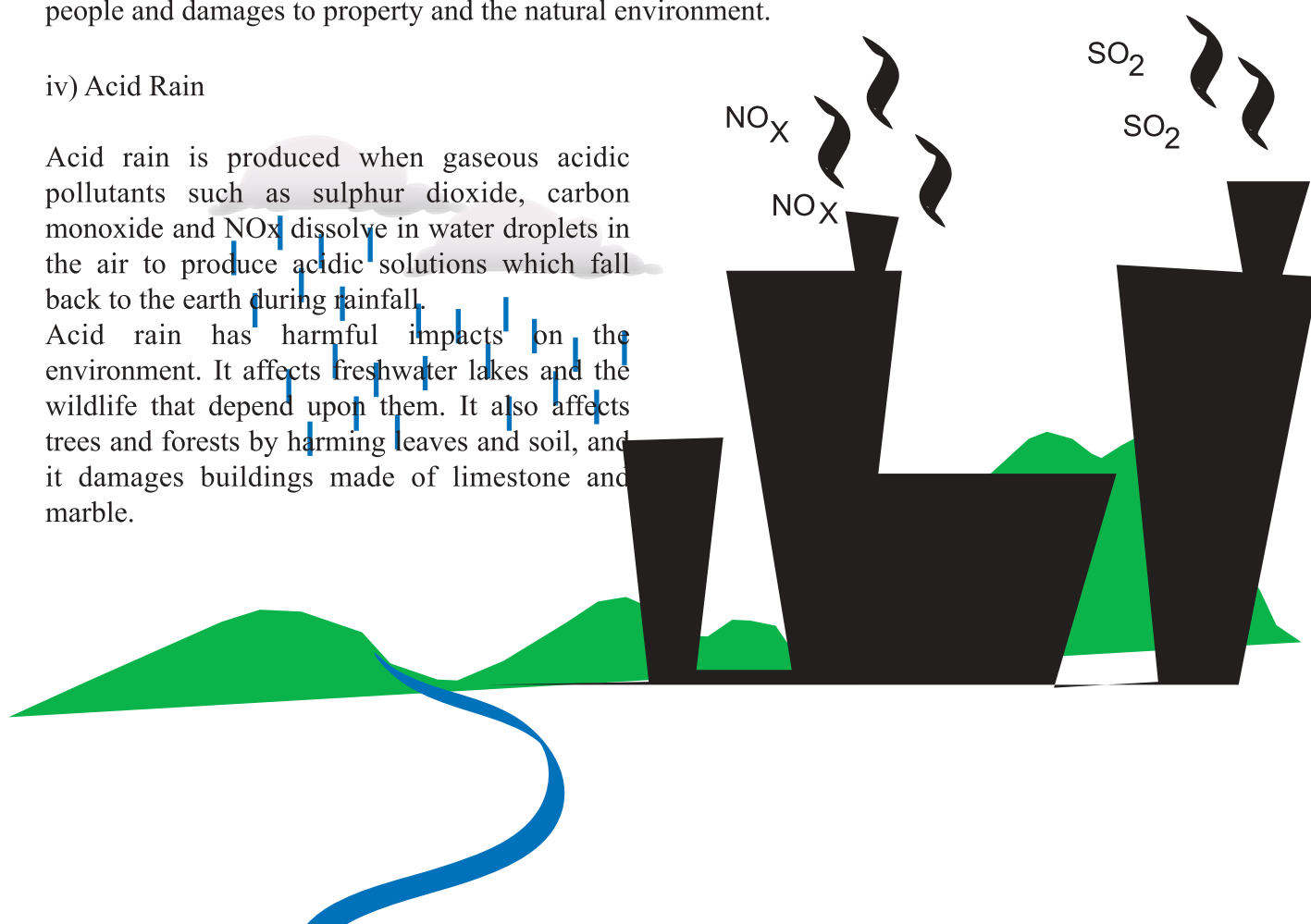
iii) Effects on the Economy

Air pollution will have serious costs for the economy due to increased health problems among people and damages to property and the natural environment.

iv) Acid Rain

Acid rain is produced when gaseous acidic pollutants such as sulphur dioxide, carbon monoxide and NO_x dissolve in water droplets in the air to produce acidic solutions which fall back to the earth during rainfall.

Acid rain has harmful impacts on the environment. It affects freshwater lakes and the wildlife that depend upon them. It also affects trees and forests by harming leaves and soil, and it damages buildings made of limestone and marble.




1.2 Introduction to Solid Waste

1.2.1 Solid Waste Definition

Solid waste can be defined as: the useless and unwanted products in the solid state derived from the activities of and discarded by society. It is produced either as a by-product of production processor or arises from the domestic or commercial sector when objects or materials are discarded after use.

As termed in Solid Waste and Public Cleansing Management Act (2007); solid waste is defined as any scrap materials or other unwanted surplus substance or rejected products arising from the application of any process; or any substance required to be disposed as of being broken, worn out, contaminated or otherwise spoiled; or any other material that according to this Act or any other written law is required by the authority to be disposed of.

source: (www.ea-swmc.org/download/seminar1papers/DrNadzriYahaya.pdf)







Solid Waste And Public Cleansing Management Act 2007

Solid Waste and Public Cleansing Management Act 2007 is a new act that changes the existing legislative structure whereby it gives the executive authority for the Federal Government to take over the responsibility on solid waste management from the local authorities.

The Federal Government shall have the power to enter into agreement with any person to undertake solid waste management services.

For the average person; solid waste is usually referred to in the following terms:

-  Garbage: the term given principally to food waste, but may include other degradable organic wastes.
-  Rubbish: consists of combustible and non-combustible solid waste, excluding food wastes.
-  Refuse: the collective term for solid wastes, includes both garbage and rubbish.
-  Litter: odds and ends, bits of paper, discarded wrappings, bottles etc. left lying around in public places.



1.2.2 Types of Waste

Waste is generated continuously in every single way from our daily activities. Each activity will generate different types of waste which will require its own separate or specialized treatment. The nearest example is household or domestic activities that usually generate waste in the form of food waste that is high in water content, and is usually treated or disposed of through the landfill method.

The types of waste commonly generated in Malaysia are as follows;

a) Municipal Solid Waste

Municipal Solid Waste (MSW) refers to a combination of several different types of waste: household or domestic waste, commercial waste and institutional waste. MSW is highly heterogeneous and its composition depends on factors like living standards, type of housing, seasons, country, and cultural habits of individuals.

i) Domestic waste refers to waste generated from residential homes or buildings used wholly for the purposes of living accommodation. Typically, the waste consists of organic and inorganic fractions. Organic waste includes putrescent waste, paper of all types, plastics of all types, textile, rubber, leather, wood and yard or garden waste. The inorganic fraction includes glass, crockery, tin cans, aluminium, ferrous metal and dirt. Domestic waste also includes waste components that require a different kind of handling, called bulky waste. These include items such as radios, television sets, refrigerators, washing machines, furniture, and household hazardous waste, e.g. batteries and fluorescent bulbs.



ii) Commercial waste refers to waste from premises used wholly or mainly for purposes of trade or business, or for purposes of sport, recreation or entertainment. Such premises may include stores, restaurants, markets, office buildings, hotels, print shops and petrol service stations. The types of waste are similar to domestic waste. However, the composition of waste depends on the source.



MODULE 1: SOLID WASTE AND THE ENVIRONMENT

iii) Community waste refers to waste generated from public places as a result of activities undertaken by local authorities (operation and maintenance of municipal facilities and provision of other municipal service including street cleaning, landscaping, catch basin cleaning, parks and beaches and recreational areas). The types of waste include rubbish, special waste including dead animals and bulky waste, debris from street sweeping and drain cleansing, landscaping and tree trimming, and green waste.



iv) Construction & renovation waste refers to waste generated from any construction or demolition site, and may include road repair / renovation sites, building demolition, and broken pavement. The composition is variable but may include dirt, stones, concrete, bricks plaster, lumber, shingles and steel.



v) Institutional waste refers to solid waste generated from government centres, schools, places of worship, and hospitals (excluding clinical waste). The types of waste generated are relatively similar to those of domestic waste.

b) Hazardous Waste

These types of waste represent a potential danger, immediate or not, to human life, wildlife and plants. Solid waste is categorised as dangerous if it has the following characteristics:

- i) inflammable
- ii) corrosive
- iii) reactive
- iv) toxic

c) Industrial Waste

Industrial waste comprises wastes generated from industrial premises through industrial processes (some of these could also include hazardous waste). The types of industrial waste include industrial process waste, scrap materials and waste similar to domestic waste component in variable degrees of composition. Industrial wastes include solids, liquids, sludges and gases.



1.2.3 Source of waste

Sources of waste can be everywhere and vary widely. Nonetheless; it can be narrowed down as below;

- a) Domestic or Municipal - from homes and offices come a complete range of materials such as paper, plastics, organic, hazardous (insecticides, cleaning products).
- b) Industry/Manufacturing – the “non- value” waste materials from processes.
- c) Agriculture - vegetation from clearing land, empty containers from pesticides, fertilizers.
- d) Construction - debris, concrete, metal, paint, tiles, and other related unwanted construction materials.
- e) Hospital/ medical - medical wastes, used needles, spent and out dated drugs.
- f) Hazardous – materials which exhibit ignitable, corrosive, reactive, or toxic characteristics.

1.2.4 What are the Problems and Issues Relates to Solid Waste?

Scenarios such as litter by the roadside, drains clogged up with rubbish, and rivers filled with filthy garbage are definite indicators that solid waste is a major environmental problem in Malaysia. Rapid development, population increase and changes in consumption patterns directly or indirectly have resulted in the generation of enormous amounts of waste from biodegradable waste to synthetic waste. As of the year 2008, 23,000 tonnes of waste is produced each day in Malaysia and waste generated in Selangor state in 1997 was over 3000t/day and the number of waste is expected to rise till 5700t/day in year 2017 (Yachio Engineering, 2000 cited in Muhd Noor Muhd Yunus, 2000). Unquestionably this situation has been and will be reducing our environment's capacity to sustain life.

Despite the massive amount and complexity of waste produced, the standards of waste management in Malaysia are still poor. These include outdated and poor documentation of waste generation rates and its composition, inefficient storage and collection systems, disposal of municipal wastes with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilization of disposal site space.

Furthermore, the lack of awareness and knowledge among Malaysians with regards to solid waste management (SWM) issues and ignorance about the effects that improper SWM has definitely worsened the problem.



This particular section will explain and justify what are the main surrounding issues and problems of solid waste in Malaysia.

a Amount and component of solid waste generated:

Generation of waste; person per day; in Malaysia may decrease or increase based on the economic status of a particular area. Normally, generation of waste for one person per day is estimated at 1kg/day; however; the rate has increased to 1.1 – 2.0 kg/day/person (source KPKT). In 2002, solid waste generated in Peninsular Malaysia was 17,000 tonnes per day and in 2005, 19,000 tonnes per day of waste was generated in Malaysia (FMM Seminar on “Understanding Requirements of the National Solid Waste Legislations”, March 2008). Furthermore, generation of solid waste is expected to reach about 30,000 tonnes per day in year 2020 which is approximately equivalent to 10.95 millions tonnes per year.

Apart from increasing amounts of waste, we also face the problem of the components of solid waste produced. The ninth Malaysia Plan estimated that 45% of waste consists of food waste (organic waste), followed by 24% plastic, paper and iron with 7% and 6% respectively, 3% glass and 15% of other waste (FMM Seminar on “Understanding Requirements of the National Solid Waste Legislations”, March 2008).

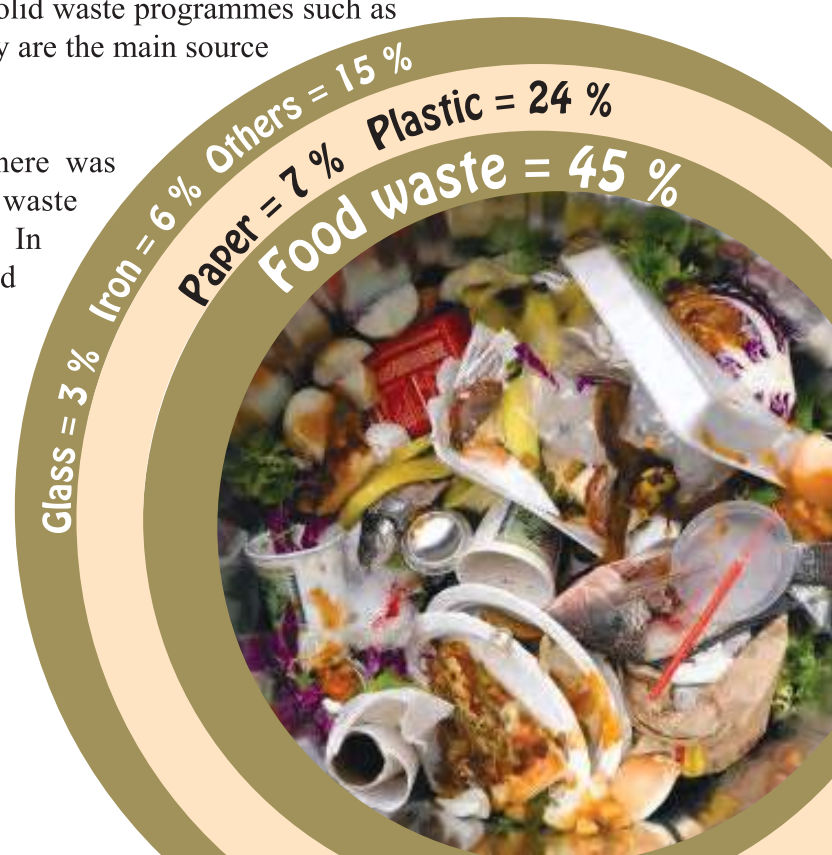
The Consumers’ Association of Penang (2001) stated that the biggest composition of solid waste produced in Malaysia is organic waste with a high moisture content and bulk density of above 200kg/m³. It also stated that the amount of organic waste produced from residential areas in Kuala Lumpur range between 2% and 72%.

This situation obviously indicates that the amount and components of waste we are generating is continuously increasing at an alarming state.

b Limited community initiative and participation

The community or consumer can have a significant impact on managing solid waste. However, most communities are not actively involved in solid waste programmes such as recycling or composting despite the fact that they are the main source of waste generated.

A survey was conducted and revealed that there was barely any sorting activity at the source of waste (Nasir et.al., 1995b cited in Nasir et.al., 1999). In addition to that, the News Strait Times reported that only 5% of 600,000 residents in Petaling Jaya sort their waste (Selangor Runs out of Garbage Space, NST, November 2008). As the result, our waste is sorted by scavengers. However, the amount of our waste that is separated by the scavengers for recycling purposes is only 2% (Ministry of Local Government & Housing, 1992 cited in Nasir et.al. 1999), which is still not enough to curb solid waste problems.

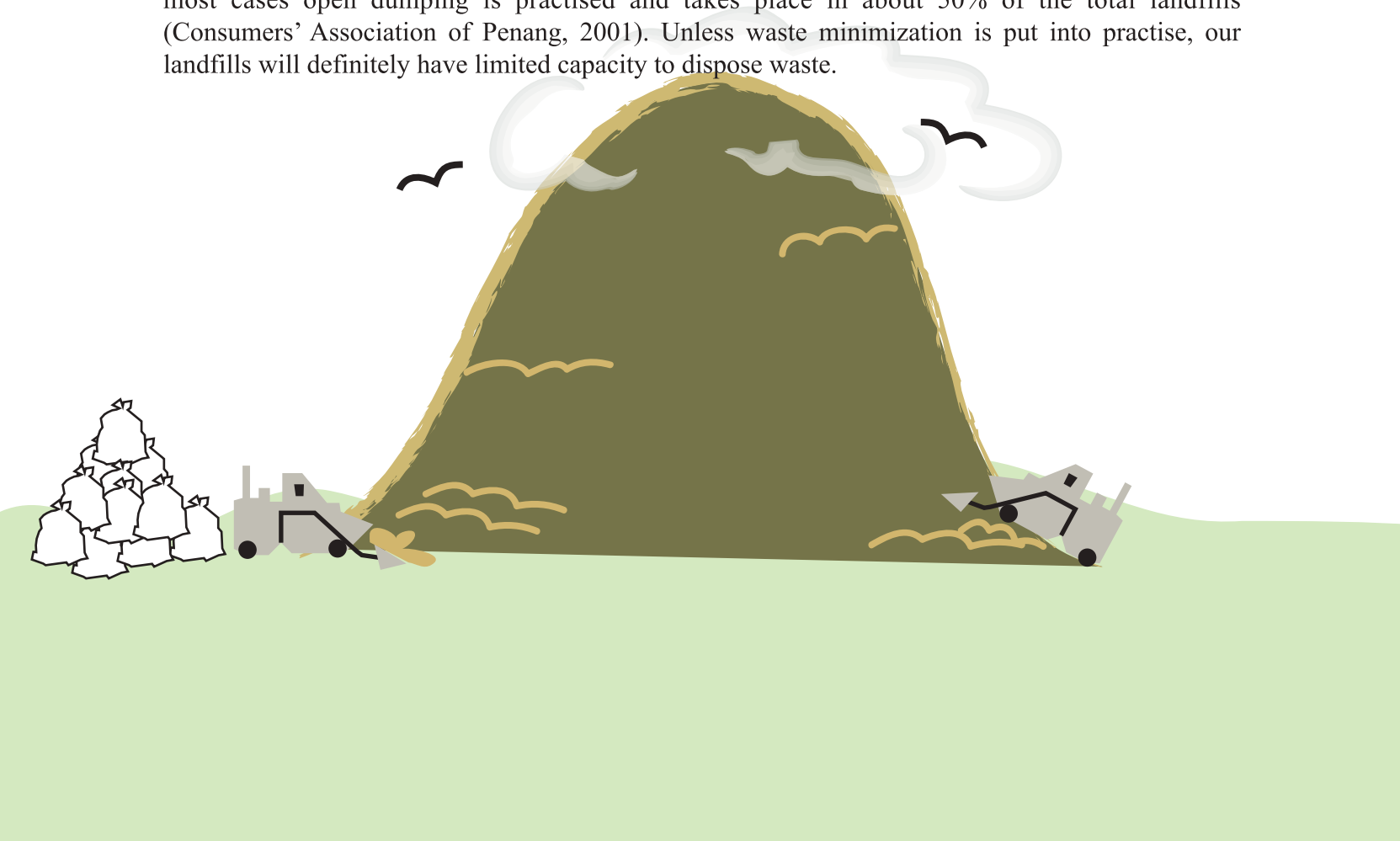


Comparison of Recycling Percentage within Developed Countries.

COUNTRY	PERCENTAGE (%)	<div>The amount of waste recycled in Malaysia is still very low compared to some developed countries. Current rate of recycling in Malaysia is only 5% and this is expected to reach 22% by 2020. (source: MHLG, 2009)</div>
GERMANY	74	
BELGIUM	71	
AUSTRIA	67	
NETHERLANDS	66	
IRELAND	36	
GREECE	33	
MALAYSIA	5	

c Disposal site:

Disposal of our solid waste is currently being done mainly through the landfill method. This may not be the best option because every single item of waste is dumped at landfills while there is low implementation of waste minimization culture among Malaysians. There are 289 landfills all over Malaysia and 113 landfills are not operating (source MHLG in Public Participation on Solid Waste Management (Commercial Premises), Seminar on Pilot Project LA21 KL: Clean and Beautiful City, 3rd March 2009). Similarly, there are about 177 disposal sites in Peninsular Malaysia and in most cases open dumping is practised and takes place in about 50% of the total landfills (Consumers’ Association of Penang, 2001). Unless waste minimization is put into practise, our landfills will definitely have limited capacity to dispose waste.

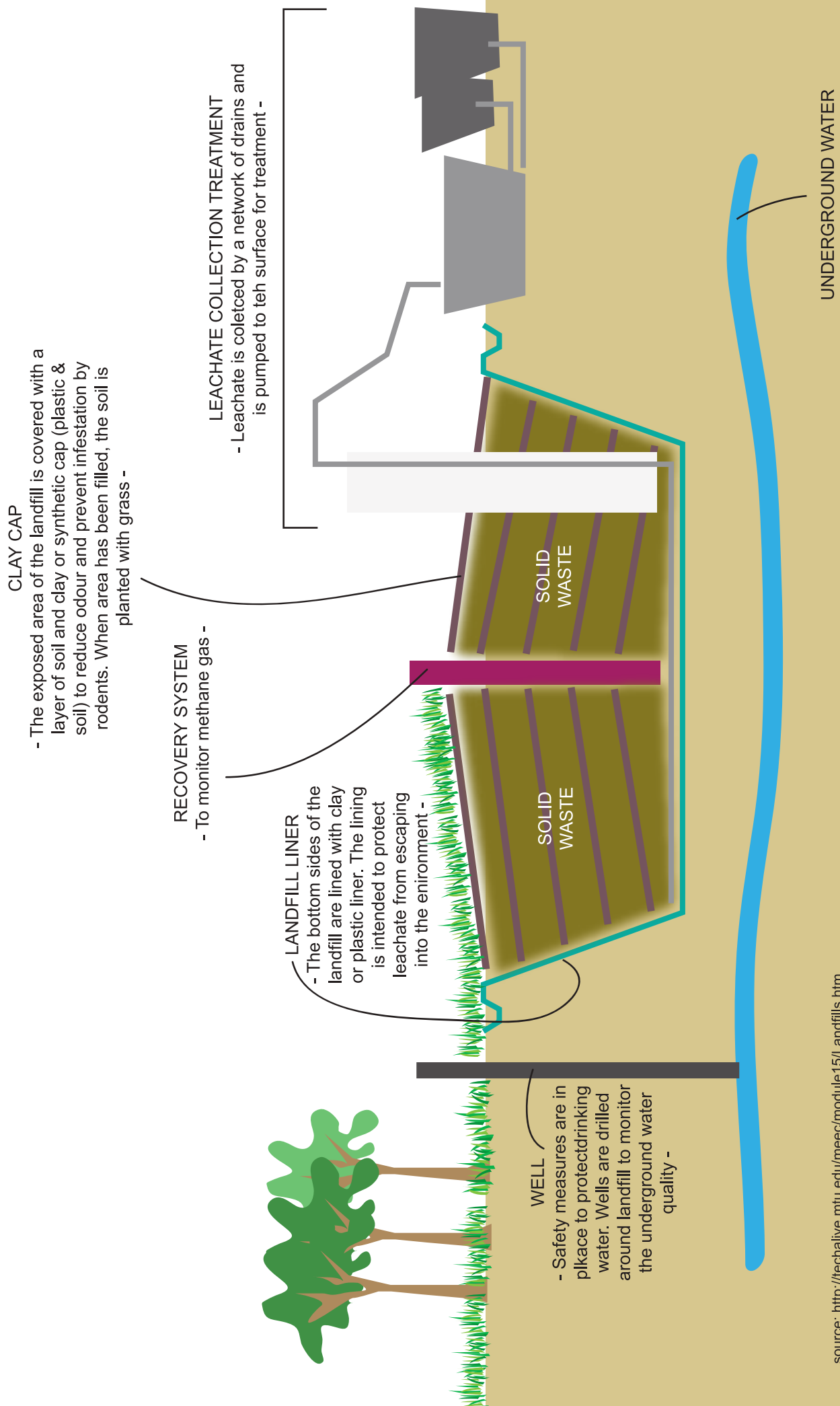


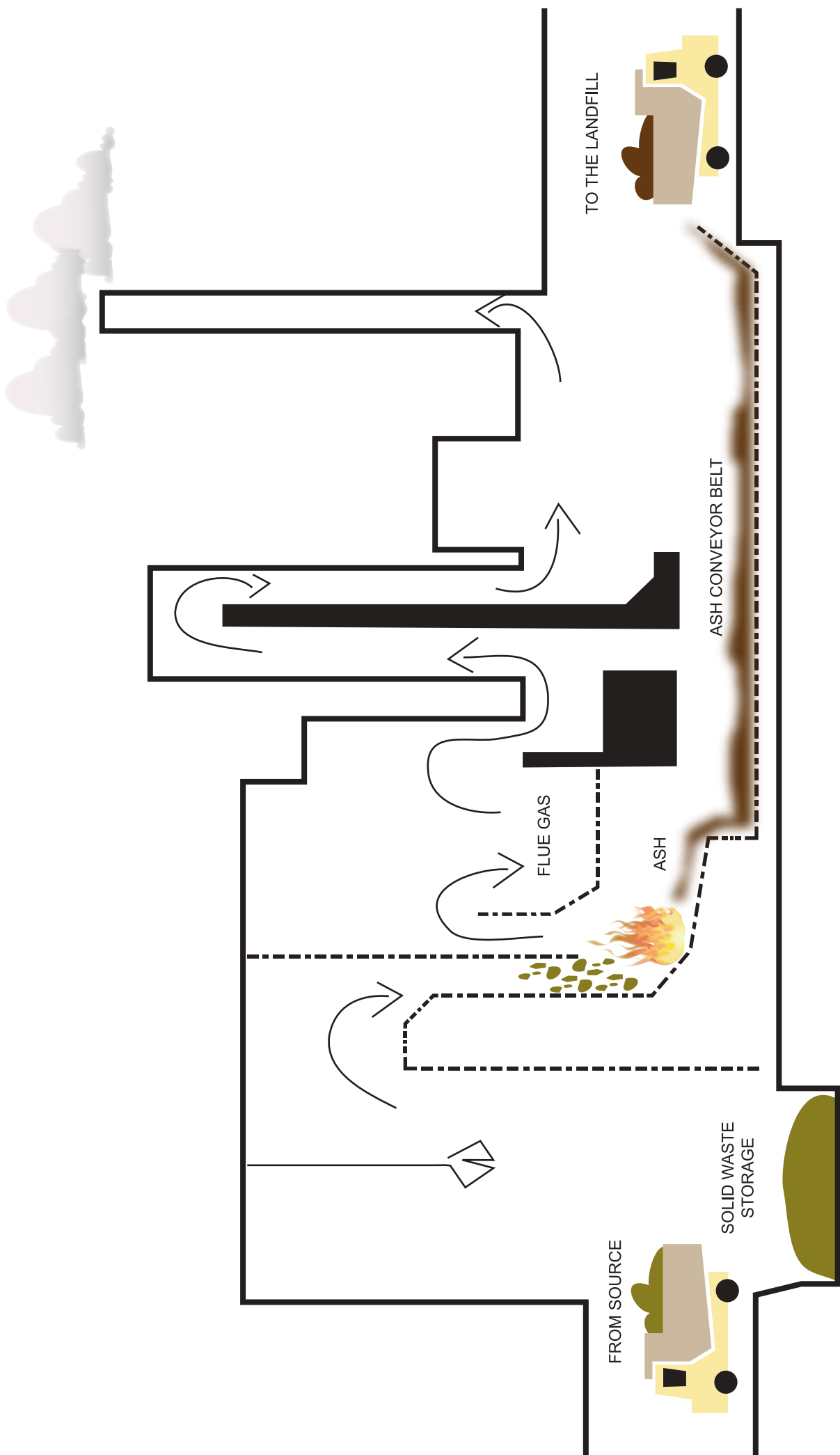
- d** Inadequate or insufficient regulation, guideline and planning as well as enforcement to control and manage solid waste

Lack of strategies, direction and proper planning may be the cause of the problem such as the existence of short term contractual agreements and absence of support for a recycling mechanism at community level. Under these circumstances, local governments currently spend approximately 40% to 70% of our access tax for rubbish collection and disposal. In the Seventh Malaysian Plan (1995 - 2000), the Federal government spent RM 20.9 million just to build 9 sanitary landfills and upgrade 27 existing landfills in 34 local authorities (Consumers' Association of Penang). Therefore, proper planning, smart partnerships and commitment among key players in solid waste management is needed and crucial for an effective management of solid waste.

- e** Outdated and poor documentation


Having reliable and updated data on solid waste generation and rate is quite a necessity as this will ensure that any programme that relates to waste especially a waste management plan is a success. As pointed out by Nasir et.al. (1999), there is currently outdated and inaccurate database on solid waste in Malaysia which is the result of the lack of periodic and systematic analysis as well as documentation of waste generation rates. Nevertheless, there has been some good effort put in for data compilation by the Ministry of Housing and Local Government.





1.2.5 Impacts of Solid Waste on Our Environment

Improper handling of these wastes can pose direct threats to our environment and health. Almost all the life of a human is connected with wastes. Most of them are not dangerous to the environment and health if properly treated. However, an unsatisfactory and ineffective system for the collection, storage and removal of wastes may result in negative impacts on the environment and human health.

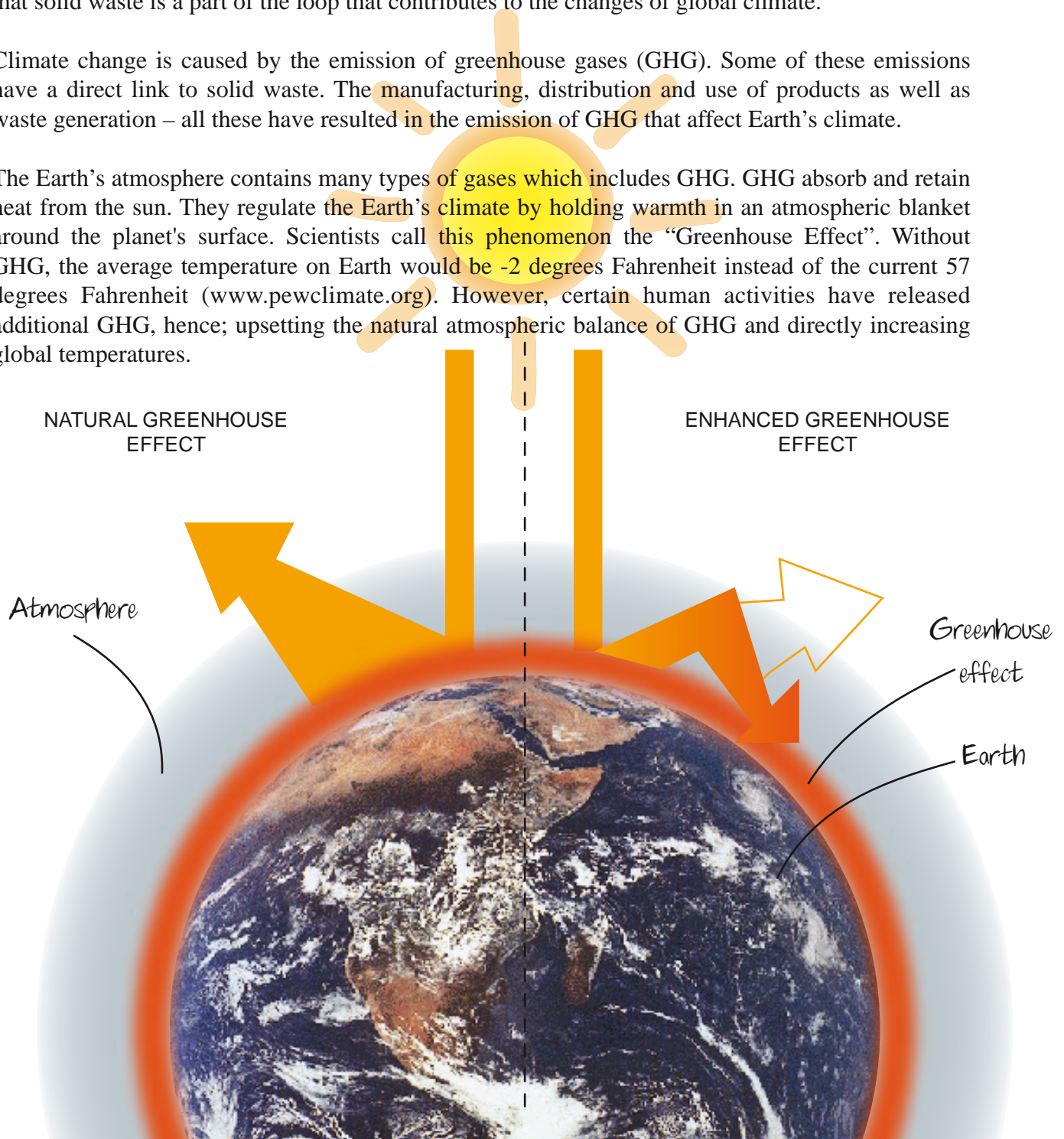
 This particular section will explain what are the impacts of solid waste on the environment.

Solid waste impacts on climate change (Greenhouse Gas)

Many people may know that climate change is caused by deforestation or human activities such as open burning that releases huge amounts of carbon dioxide. However, many people may not know that solid waste is a part of the loop that contributes to the changes of global climate.

Climate change is caused by the emission of greenhouse gases (GHG). Some of these emissions have a direct link to solid waste. The manufacturing, distribution and use of products as well as waste generation – all these have resulted in the emission of GHG that affect Earth's climate.

The Earth's atmosphere contains many types of gases which includes GHG. GHG absorb and retain heat from the sun. They regulate the Earth's climate by holding warmth in an atmospheric blanket around the planet's surface. Scientists call this phenomenon the "Greenhouse Effect". Without GHG, the average temperature on Earth would be -2 degrees Fahrenheit instead of the current 57 degrees Fahrenheit (www.pewclimate.org). However, certain human activities have released additional GHG, hence; upsetting the natural atmospheric balance of GHG and directly increasing global temperatures.



MODULE 1: SOLID WASTE AND THE ENVIRONMENT

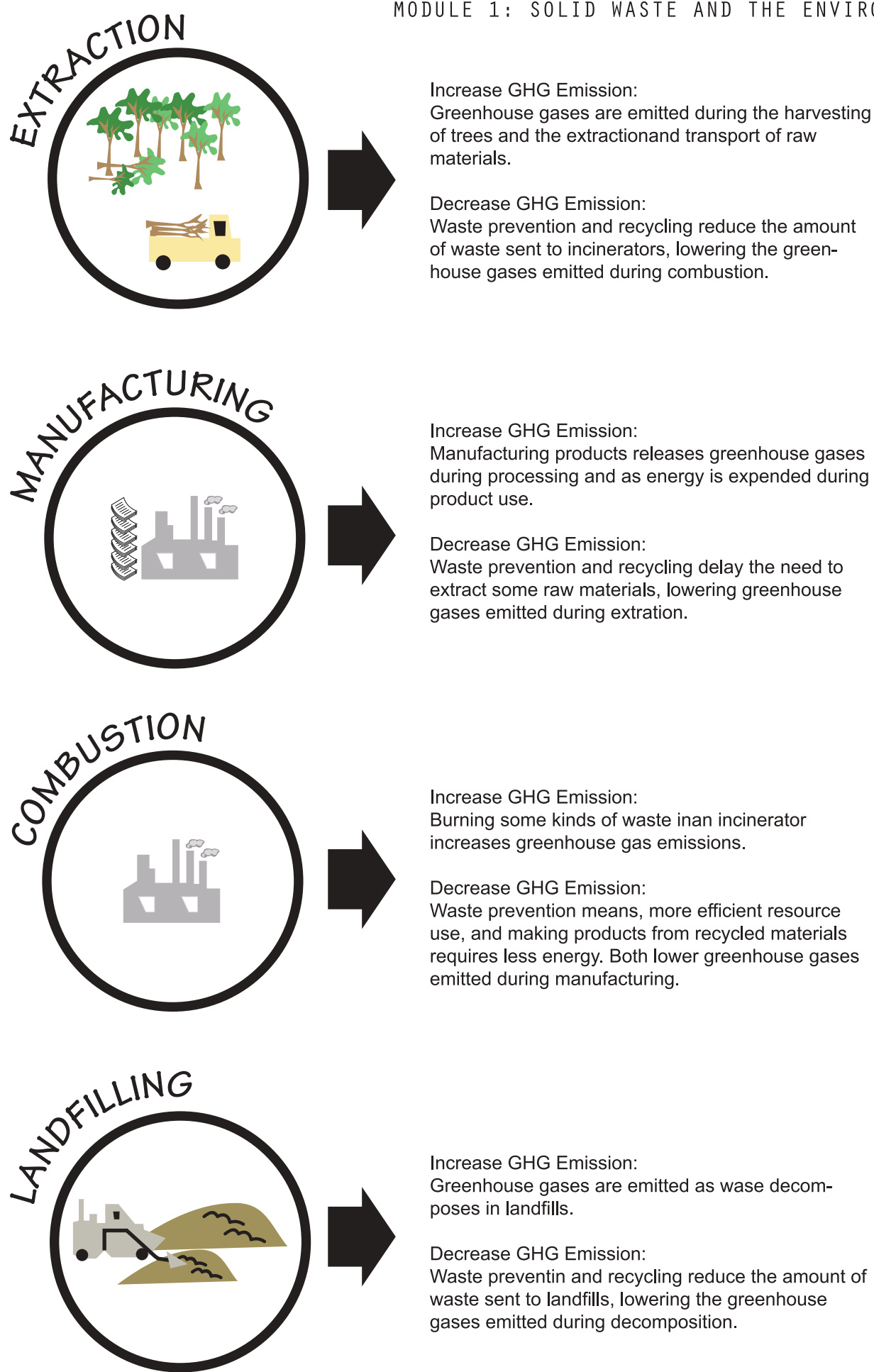


Figure 1.1: The link between waste management and greenhouse gases

● SMART facts ●



What are GHG gases consist of ?

- **Carbon dioxide** is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.
- **Methane** is emitted during the production and transport of coal, natural gas, and oil; the decomposition of organic wastes in municipal solid waste landfills; and the raising of livestock.
- **Nitrous oxide** is emitted during agricultural and industrial activities, as well as during the combustion of solid waste and fossil fuels.

Several classes of halogenated substances are also greenhouse gases:

- **Hydrofluorocarbons (HFCs)**, **perfluorocarbons (PFCs)**, and **sulfur hexafluoride (SF6)** are potent greenhouse gases that primarily result from industrial activities. Sources of HFC missions include foams, refrigeration, air-conditioning, solvents, aerosols, and fire extinguishing sectors. PFCs and SF6 are predominantly emitted from industrial processes, including magnesium casting, aluminum smelting, semiconductor manufacturing, and electric power transmission and distribution systems.

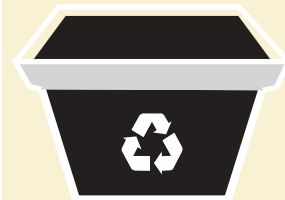
As previously mentioned, solid waste affects climate change. It affects climate change through landfill methane emission. The source of manmade methane gas is from landfills. Emission of methane gas happens when organic waste is left to decay anaerobically in landfills which will produce methane gas. According to a website source from www.cawrecycles.org, methane gas is 23 times more potent at trapping heat in the atmosphere than the common GHG we know that is carbon dioxide. In addition, EPA (1999a) stated that landfill methane accounts for approximately 4% of all GHG emission.

b Solid Waste impacts on Water Quality

Water and good water quality is essential to life. The impact of solid waste on water quality is through the release of leachate from landfills into a water source. As water comes in contact with decomposing solid waste, it will dissolve together with soluble inorganic and organic wastes to produce a polluted liquid known as leachate or waste juice.

The concentration of leachate increases as it seeps into deeper layers of landfill; consequently producing light brown to black colour leachate with a sickly smell. It has polluting potential impact due to its high organic contaminants concentrations and high ammonical nitrogen. Once leachate is discharged into water bodies or/and aquatic environment, it will have an acute and chronic impact. If toxic metals are present, this can lead to chronic toxin accumulation in every single organism that depends on it particularly the end user which is human (Wikipedia, 2009).

● SMART fact ●



For every 3500 tonnes of rubbish (one tone of garbage produces 150 litres of leachate), about 525 000 litres of leachate is produced.

source: StarMetro: Monday, 27 April 2009

c Solid waste impacts on energy consumption

Energy is invisible yet it is used in every single range of activities. This is the less visible part and most people are unable to notice the impact solid waste has on the environment i.e., energy consumed.

More energy is consumed when an item is made from raw/virgin material rather than recycled material. For example, the production of paper requires a process of extraction of trees and manufacturing it into paper. This process uses a lot of energy in terms of harvesting trees, transportation of raw materials and electricity use in industry. When the paper is used, it is considered waste which eventually ends up in a landfill or incinerator. On top of that, the steps of producing a product from raw material till the end use of the product emits GHG from the process of manufacturing products and fossil fuel burning during transportation

The scenario would be much worse if there is such high demand for products made from raw material to replace the discarded ones because more raw materials will be extracted more energy will be used and more waste will be produced.

d Solid waste impact on carbon footprint

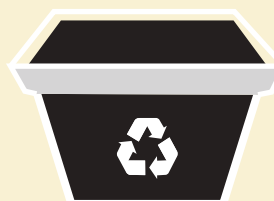
What is your Carbon Footprint?

Your carbon footprint is the direct effect your actions and lifestyle have on the environment in terms of carbon dioxide emissions. All your actions have a direct and indirect impact for instance your diet, the clothes you wear, the car you drive and so on. The biggest contributors to your footprint are your travel needs and your electricity demands at home. Your personal electricity needs generally come from fossil fuel burning power plants.

By not reducing your consumption, you leave behind a larger Carbon Footprint because more energy is used to power your home and to manufacture products such as aluminium cans, plastic water bottles, paper and so on. So reduce consumption and recycle glass, metals, plastics and paper. In the final tally, all your actions contribute to accelerating global warming and climate change. Living sustainably will go a long way towards making sure that our planet's resources can continue to sustain future generations.

To calculate your Carbon Footprint log on to <http://www.carbonfootprint.com/calculator.aspx> or www.defra.gov.uk

SMART facts



The IPCC estimates that primary (virgin material) production causes 40 times the greenhouse emissions of secondary (recycled material) production per ton of aluminum. For many other industrial materials, primary production emissions are 4 to 5 times as great as secondary emissions per ton.



The disposal of solid waste produces GHG emission through 2 ways.

- 1) anaerobic decomposition of waste in landfills that produce methane gas and emission of CO₂ from incinerator ;
- 2) transportation of waste for disposal, GHG emitted due to the combustion of fossil fuel, in addition to burning of fossil fuel for the process of raw materials.

e Solid waste impacts on human health

Perhaps the most important factor why we need solid waste to be managed wisely is the impact it can have on human health. Generating waste as much as possible without practising a waste prevention and minimization culture will only allow more landfills and incinerators to be build. If a situation such as “landfill in my backyard” were to happen then a situation such as “potential health hazard effects in my backyard” will also happen. Potential health effects such as birth defects, asthma, respiratory disease, cancer and birth disease (www.defra.gov.uk) are to happen if we fail to take action to prevent and minimise waste at the source.

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ASSIGNMENTS

reduce your carbon footprint
use public transport
the problem with pollution



ASSIGNMENT 1: REDUCE YOUR CARBON FOOTPRINT

Here's how:

Set up a car pool with your neighbours for the journey to work or to send the children to school or for other errands that can involve the community.

Draw up a schedule for drivers containing a list of contact details.

Identify pick up and drop off points within the neighbourhood.

Draw up a reimbursement plan for drivers so all share the costs of carpooling such as fuel money, toll, parking and others.



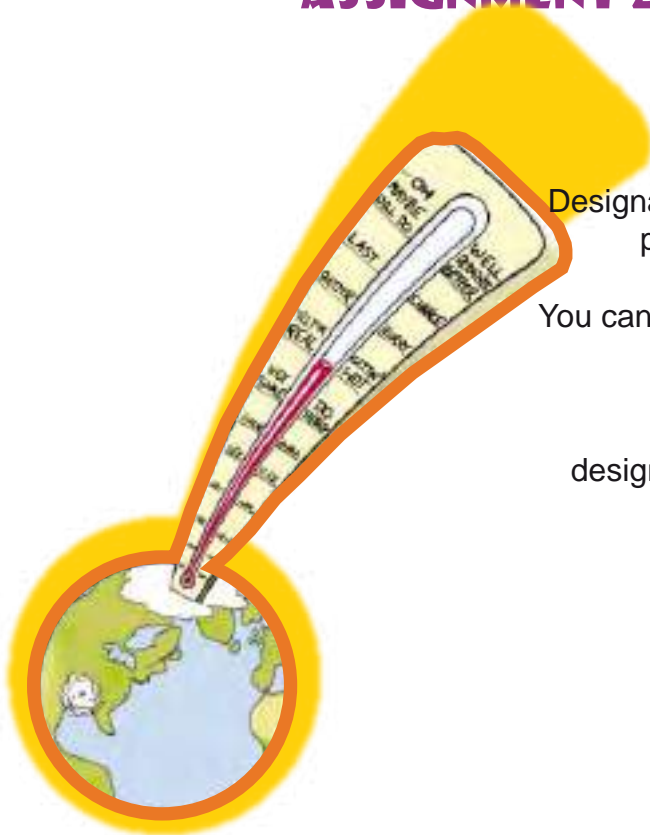
ASSIGNMENT 2: USE PUBLIC TRANSPORT

Here's how:

Designate a day in a week to start your quest to use public transport and help stop global warming

You can either walk or use a bicycle to get to work or a desired destination

Once you are comfortable with this routine, designate two or three days in a week for travel by public transport



ASSIGNMENT 3: THE PROBLEM WITH pollution

_conduct a
pollution
audit in your
home_



Here's how: Checklist for pollutants

If you ticked more than 10 items on the list then you are definitely a big contributor to land and water pollution.

Instead of using chemical ridden products at home you can use natural alternatives such as biodegradable environment friendly detergent for washing dishes, and clothes. Many such products are already on sale at major supermarkets. For more tips on natural ways to keep your home clean, check out websites like www.ecolivingcenter.com/solutions and www.geocities.com/Heartland/Prairie for the Clean and Green : Natural Homemade Household Cleaners page.

Composting is also good for healthy plants so instead of using chemical fertilizers, try making your own compost for the garden.

Make good use of the tried and proven tips above for a healthier life!

Area in the home	Pollutants	Tick if yes
Kitchen	Dish washing detergent Leftover food waste Food waste that can be composted Cooking oil, especially from deep frying Chlorox, bleach and whiteners	
Bathroom	Chemical based vs natural soap Chlorox, bleach and whiteners Products containing acid for getting rid of stains on walls and floors Laundry detergent Chemical fertiliser vs Organic fertilizer or compost	
Garden	Garden waste that can be composted Herbicide Pesticide Weedkiller	
Garage	Engine oil Lubricants Polish Old tyres Old car battery	
Miscellaneous	Old batteries Old handphone batteries	

MODULE 2

INTEGRATED WASTE MANAGEMENT

2.1 UNDERSTANDING IWM

SOLID WASTE MANAGEMENT

2.2 4R2C - ZERO WASTE CONCEPT

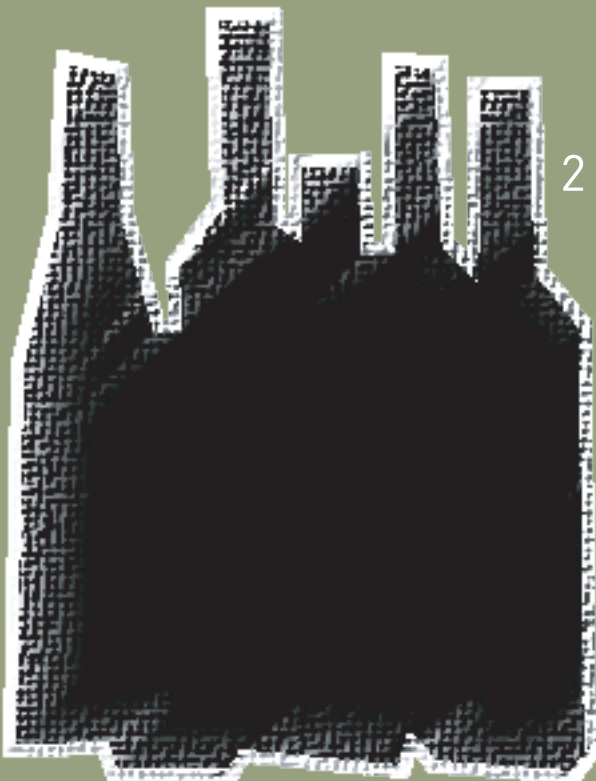
2.3 HOW DOES 4R2C HELPS THE ENVIRONMENT?

REDUCE ENERGY CONSUMPTION

INCREASE CARBON UPTAKE BY
FOREST

REDUCING THE NEED OF MORE
LANDFILLS AND INCINERATOR

2.4 HOW DOES 4R2C HELPS THE ECONOMIC ?



Module 2: Integrated Waste Management

2.1 Understanding Integrated Waste Management (IWM)



Integrated waste management (IWM) is an approach whereby decisions on waste policies and practices take account of waste streams, collection treatment and disposal methods, environment benefits, economic optimization and social acceptability. Basically, an approach or system that combine waste streams, waste collection, treatment and disposal methods, with the objective of achieving environmental benefits, economic optimization and social acceptability (Strange, 2002).

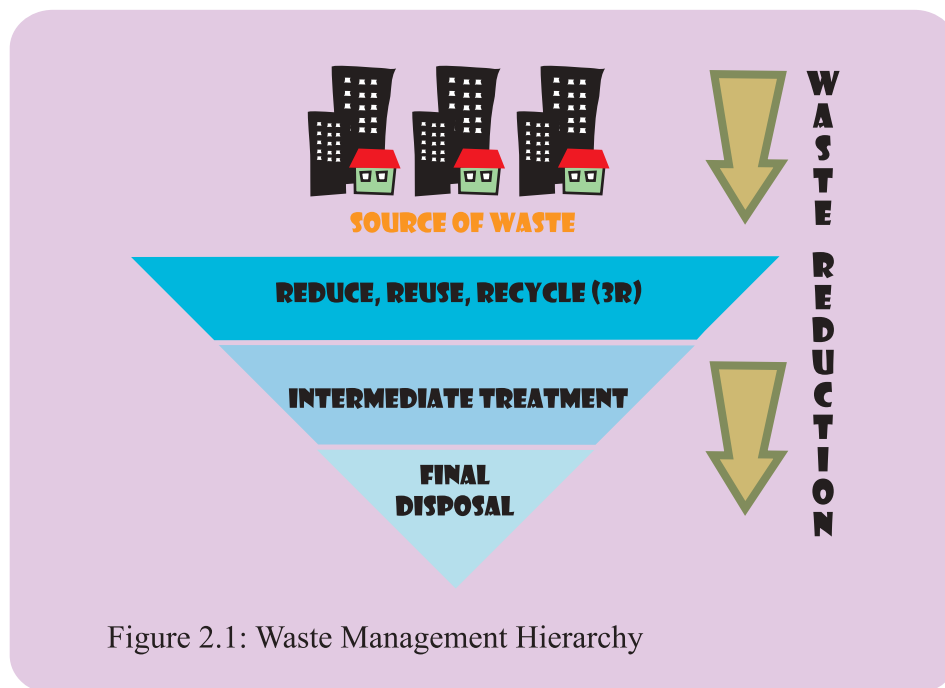
Concept undertaken with regards to IWM varies around the world. For instance, IWM in California includes public education, outreach programmes and efforts to foster markets for recyclables. IWM South Africa aims to integrate and optimize waste management in order to maximize efficiency and minimize environmental impacts and financial cost of waste and improve the quality of life of its citizens (Strange, 2002).

Noted by Stranger (2002), the IWM term does not describe a particular approach or technique to be applied with a particular waste stream. It refers to the overall approach that considers the best means to manage waste.

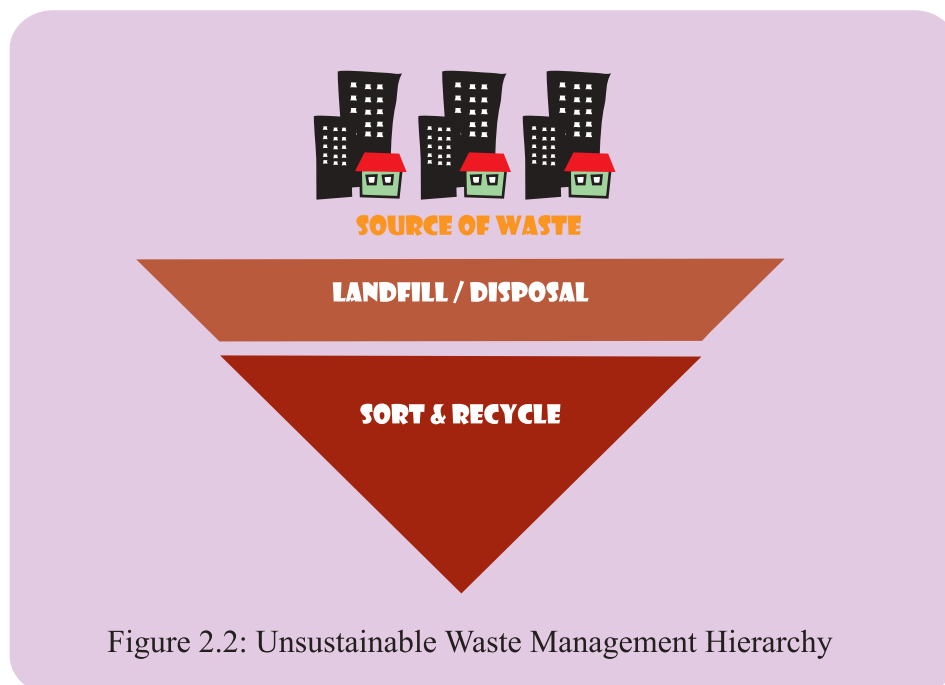
2.1.1 Solid Waste Management

Malaysia has its own national policy and its aim is to establish a comprehensive, integrated, cost effective, sustainable and socially acceptable method of solid waste management and to implement solid waste management based on waste management hierarchy which gives priority to waste reduction via 3R, intermediate treatment and final disposal.





We have adopted the sustainable waste management hierarchy progressively and aim to discard the practice of unsustainable waste management hierarchy (figure 2.2) whereby our waste sometimes is sorted and recycled by scavengers at disposal phase (i.e. landfill).



2.2 4R 2C – Zero Waste Concept

Designed by GEC, 4R 2C is a concept that refers to a certain phase of the overall Integrated Waste Management (IWM) system – meaning if the IWM is considered a pie, 4R2C is merely a small piece of it. Even though, 4R2C only covers a small part of the whole system, it is actually the most important part because it changes our current waste management habits and determines the quality and quantity of waste generated at source level and will directly have an impact on how the IWM is going to be implemented particularly on the selection of waste disposal methods (i.e. landfill or incinerator or both methods).

4R 2C concept is a concept of zero waste system. A concept that makes you an environmentally wise consumer (Rethink) via waste prevention and minimization (Reduce), reusing waste (Reuse), and maximizing recycling (Recycle). It is also a concept that ensures waste is recycled back to nature (Compost) and placed back to its market place (Close the loop). Refer to figure 2.3 for SMART Ranger zero waste chart system.

The key function of this particular zero waste system is to prevent or minimize the amount of waste generated. If there is still waste generated, then the next step is to recycle for inorganic waste and compost for organic waste. The final step is close the loop by supporting new products made from recyclables.

Following are detailed explanations of the 4R(s) and 2C(s); module 2: integrated waste management

3R Concept

3R refers to reduce, reuse and recycle, which applies to the areas of production and consumption in particular. The 3R concept is a globally recognized concept, widely used and accepted by organizations and other bodies.

4R 2C Concept

The 4R 2C concept has been designed and conceptualized by GEC, specifically tailored to suit a zero waste system environment. 4R introduces the first step (Rethink) which allows consumers to think from an environmentally friendly point of view. The 2Cs (Compost and Close the loop) were integrated to ensure that the waste is recycled back to nature, and placed back to its market place.

1) Rethink

Be an environmentally wise consumer by thinking before you purchase an item as this will help you to prevent and minimize waste generation at an earlier stage. Always think of ways you can save our precious resources. Ask yourself questions “Do I really need this item?” “Am I buying environmentally friendly products?” “What are the impacts on the environment if I were to purchase this particular item?” “What type of waste would I be recreating if I were to purchase a particular item – degradable or non-degradable?” Ask these types of questions repeatedly and spend wisely.



always think!
of ways you can save our precious resources

2) Reduce

Use less! Buy what and when is necessary. Refrain from buying items that are packaged in non – recyclable materials. Use a shopping bag instead of plastic bag to carry your items the next time you go shopping. Stop using Styrofoam to pack your food because it is not biodegradable and it contains toxic compounds that can leach into your food. Bring your own container the next time you buy food. Use a handkerchief instead of tissue paper to wipe your hands or mouth.



www.gettyimages.com

3) Reuse

Instead of throwing things away all the time, think about reusing items through nature craft. This means making things out of what we would usually throw away. A simple tin can could become a beautiful pencil holder (Refer to Module 3 to find out examples of nature craft). By reusing things, you can save landfill space as well as save natural resources.



shafinaz / GEC



GEC

4) Recycle

Turn your waste into resources. Collect, sort and recycle all the recyclable materials. Among the materials that can be recycled are newspaper, magazines, books and brochures, loose white and mixed paper, cardboard (including tissue boxes, shoe boxes and other cardboard boxes), glass bottles, aluminium cans, plastic bottle (labeled as PET 1, HDPE 2, LDPE 4), metal tins and cans, tetrapak cartons, electronic waste. Refer to Module 3 for a detailed explanation on how to collect, sort and recycle your waste through The Art of Recycling.



sk sri kelana



sk sri kelana

5) Composting

The scientific definition of compost as provided by Strange (2002) describes it as a product of natural degradation of botanical and putrescent waste (food waste) by the action of bacteria, fungi, insects and animals in the presence of adequate air supply. The biological decomposition process breaks down complex organic substances into carbon dioxide, water and a residue known as compost. In other words, you can turn your vegetables, fruits and garden waste (organic waste) into organic fertilizer through composting. Refer to Module 3 for a detailed explanation on how to compost your organic waste.



c mpост



4) Close the loop

The foremost important step is to buy products made from recycled material. Taking your beverage containers to a recycling centre is just the beginning of the recycling process. Those materials won't really be recycled until companies use them again to make new things and people buy them. When you buy products made from recycled materials, you are CLOSING THE LOOP.

SMART RANGER ZERO WASTE CHART SYSTEM

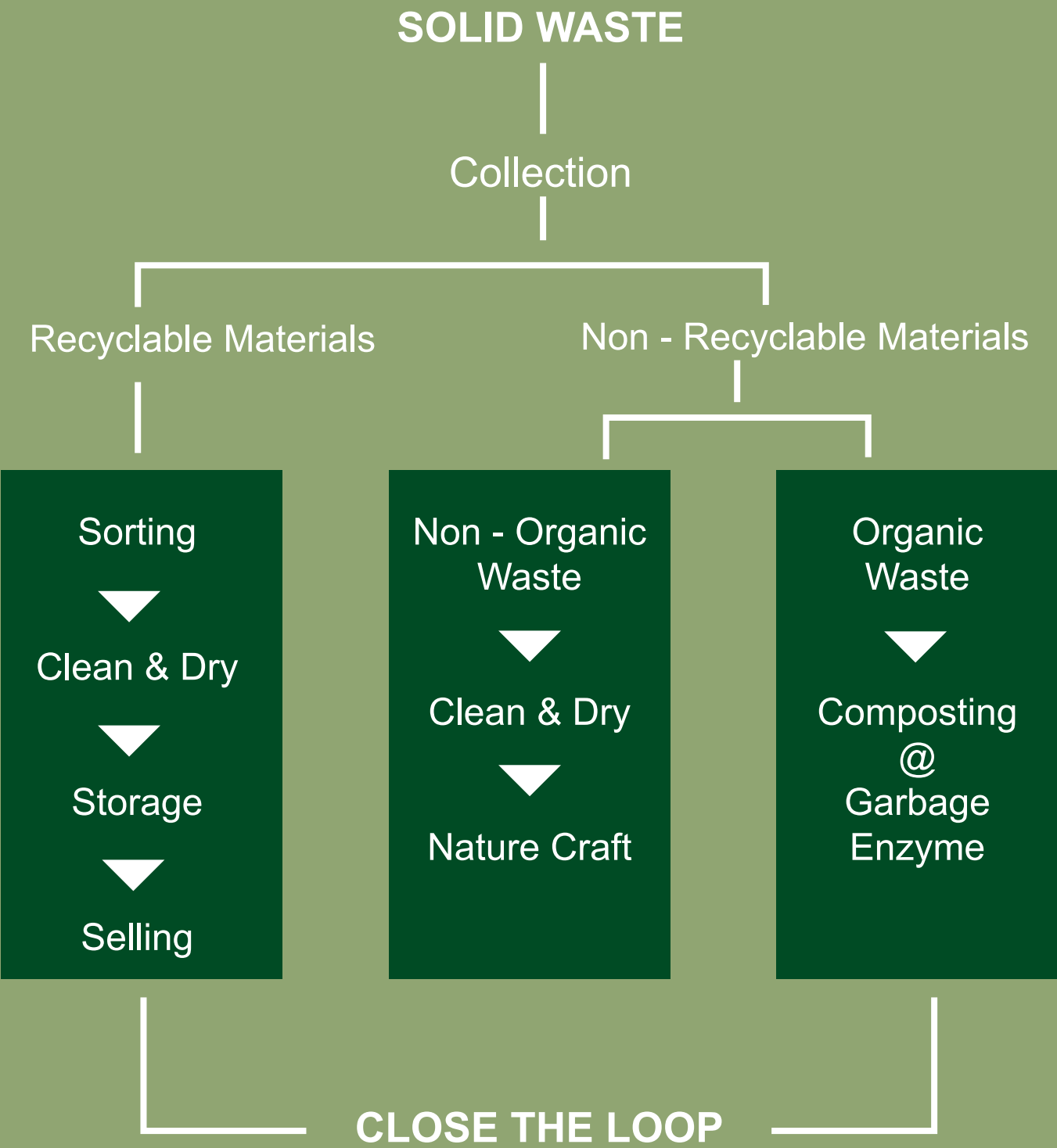


Figure 2.3: SMART Ranger Zero Waste Chart System

2.3 How Does 4R2C Help the Environment ?

As previously mentioned, 4R 2C is a zero waste system that emphasizes on a holistic approach to waste prevention and minimization. A reduced effect of waste source will have a tremendous direct impact on our environment. Below are some of the benefits of 4R 2C.

2.3.1 Reduce Energy Consumption



Reducing, reusing and recycling will save energy. Waste prevention culture via reducing and reusing a product will ensure less material is used and less energy is needed to extract, transport and process raw materials and to manufacture products. On top of that, supporting recycling activities and purchasing goods made from recycled materials will ensure that less energy is required as it only goes through a redesign phase rather than being manufactured from virgin materials i.e., from scratch. What are the benefits? When energy demand decreases, fewer fossil fuels are burned and less carbon dioxide is emitted into the atmosphere.

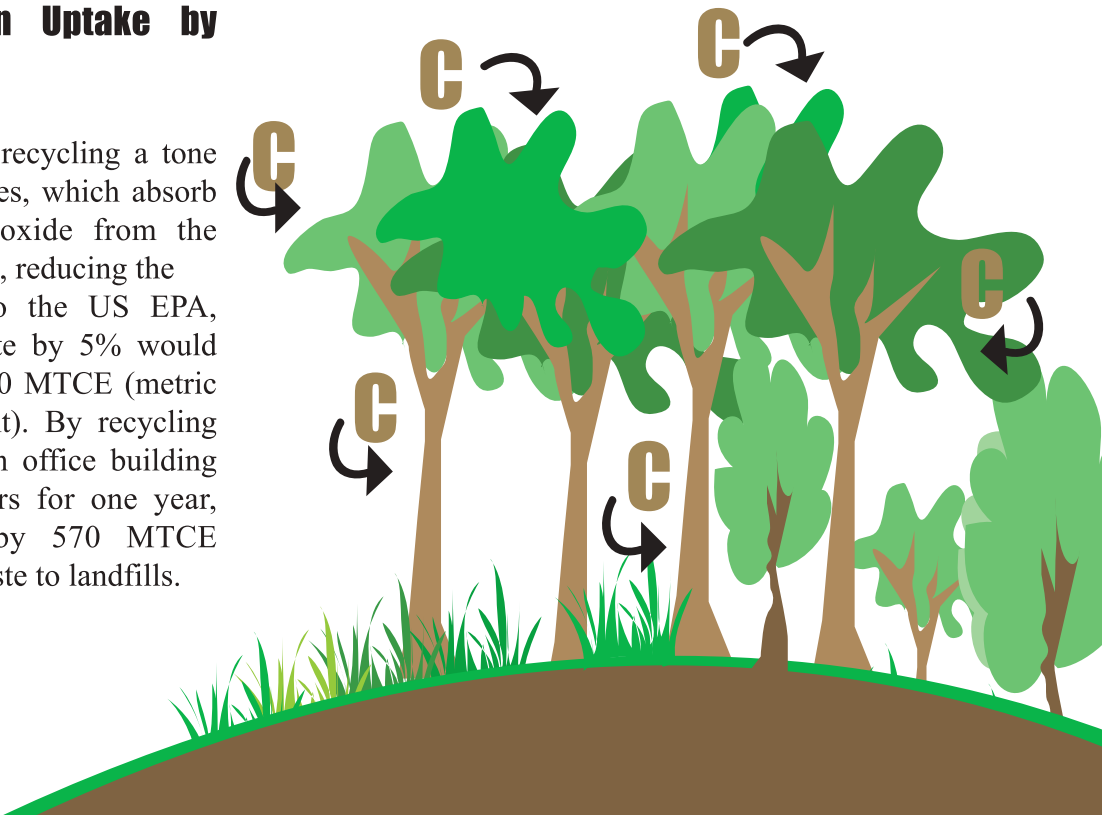
Reducing, reusing and recycling not only save GHG from being emitted but also reduce the release of chemicals by the manufacturing industry, reduce health hazards and reduce environmental degradation while preserving natural and pristine places.

SMART fact

Extracting and processing petroleum into common plastic containers (PET 1 and HDPE 2) takes 4 to 8 times more energy than making plastics from recycled plastic.

2.3.2 Increase Carbon Uptake by Forest

Stated by Sheehan (2000), recycling a tone of paper saves about 24 trees, which absorb 250 pounds of carbon dioxide from the atmosphere each year, hence, reducing the GHG effect. According to the US EPA, increasing the recycling rate by 5% would reduce GHG emission by 10 MTCE (metric tonnes of carbon equivalent). By recycling all office paper waste in an office building which houses 7000 workers for one year, GHG will be reduced by 570 MTCE compared to sending the waste to landfills.



MODULE 2: INTEGRATED WASTE MANAGEMENT

Scenario 1:
Throwing away 100 tonnes of paper
Waste Management Impact:
62 MTCE

Scenario 2:
Recycling 50 tonnes of paper
Waste Management Impact:
- 3 MTCE
Net GHG Emission Savings: - 65 MTCE

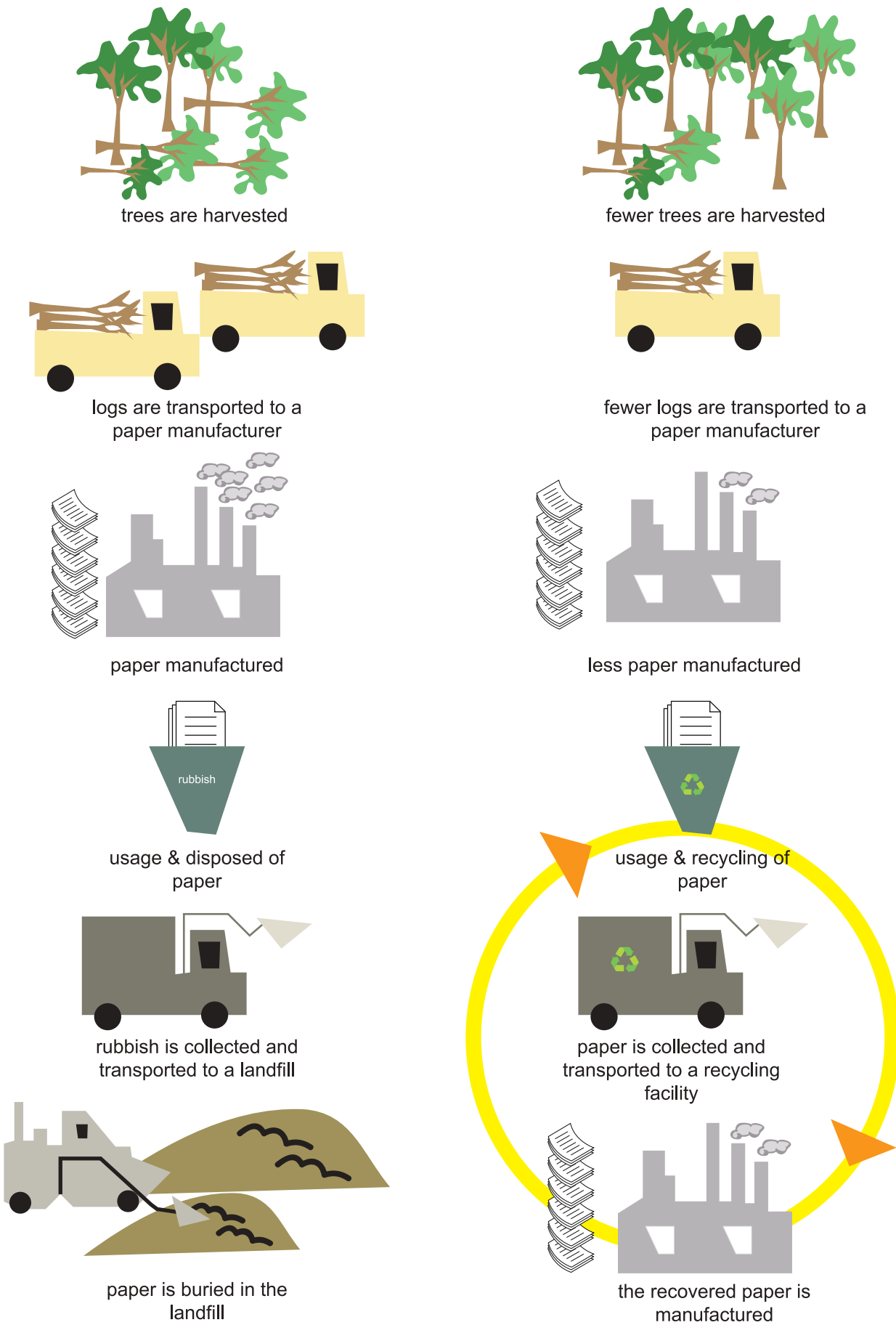


Figure 2.4: Comparison of waste management impact on GHG emission between using a material made from recycled materials and new resources.

2.3.3 Reducing the Need for More Landfills and Incinerators

You might be thinking why we should reduce, reuse and recycle when waste is still produced at the end of the day. This is true as generating waste is not only a part of the human lifestyle but of all living things on earth. The difference is the amount and type of waste produced by humans that significantly affects the environment. By sorting waste through recycling and composting, we are able to reduce the amount of waste being dumped into landfills and/or incinerators.

You might think why sort waste when current landfills are equipped with the latest technologies that allow methane gas or leachate to be captured and recovered hence reducing their negative impact on the environment. The problem is, this is true only for some landfills in a number of developed countries. From the point of view of managing waste, it seems reasonable. However, from the point of view of a zero waste system it seems less reasonable. Over 62% of the waste that is buried in landfills is readily recyclable, organic waste that can be composted and is important to replenish soils (i.e. paper, garden waste, fruit peels, and vegetable leftovers). However, when these types of organic waste are mixed with numerous toxic products from household and industrial waste, they become too contaminated to be applied in soils. The only solution is simply to sort and compost this organic wastes at home (the source). Again, this ensures the right quality of organic waste is not wasted and ensures fewer waste being sent to landfills. Hence, reducing the demand for more landfill to support waste.

Some may say that the incinerator is an alternative solution to reduce waste and at the same time lessen global environmental impact by energy capture and reducing the need to burn other fuels. These may not be true due to two reasons as noted by Sheehan (2000). The energy captured through incineration is prevailed over by the production of toxic emission (acid gases, mercury, dioxin and furans) and toxic ash. The second reason is that the energy required to burn waste is higher than energy required for recycling used materials.

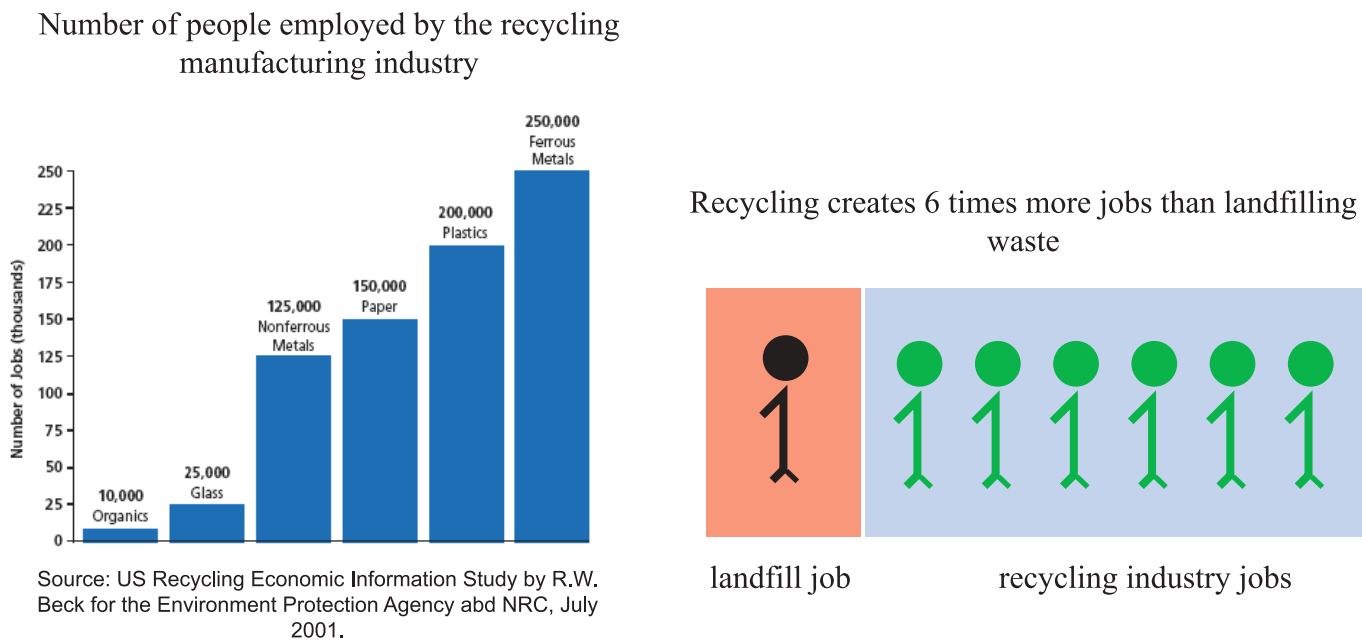


2.4 How Does 4R 2C Benefit the Economy ?

By converting waste into new products we are able to create more jobs, build more competitive recycling and remanufacturing (reuse) based companies and directly bring economic benefits for us and the country as well as the environment.

If we support waste recycling and waste reuse we are able to present a significant force in our country’s economy and make a vital contribution to job creation and economic development. In Pacific Northwest, US, one tonne of recyclables generated is worth \$74USD. In 2002, almost 900,000 tons of paper, glass, metals and plastics was recycled in Pacific Northwest and had an average economic value of almost \$64 million (www.RecycleAtWork.com).

On top of that if we all support products made from recyclables we are indirectly creating jobs for our people as proven by Pacific Northwest. Producing recycled paper creates five times the number of jobs than making paper from raw materials (www.RecycleAtWork.com).



source: www.RecycleAtWork.com

References:

1. Sheehan B. 2000. Zero Waste, Recycling and Climate Change Grass – Roots Recycling Network.
2. Strange K. 2002. Overview of Waste Management Options: Their Efficacy and Acceptability. Issues in Environmental Science and Technology, No 18. Environmental and Health Impact of Solid Waste Management Activities.
3. www.RecycleAtWork.com

ASSIGNMENTS

shopping sustainably
debate the green
a picture is worth a thousand words



ASSIGNMENT 1: SHOPPING SUSTAINABLY



TIP:

A teacher can do this assignment with students before a class trip or a family can shop for groceries using sustainable methods.

Here's how:



- Make a list of groceries needed for the class trip or for the household
- Take as many cloth/canvas shopping bags and/or baskets you may need to carry all the groceries. If buying snacks or cooked food, take a tiffin carrier or tupperwares from home.
- Carpool to the store and shop!
- Make sure you buy in bulk as less plastic would have been used to pack a large amount of food for instance a bigger bottle of juice instead of small 100 ml bottles
- Try to buy products wrapped in biodegradable and/or recyclable material like cardboard, paper and glass
- Make sure you buy only what you need so that you don't have to throw away uneaten food or unused products
- Pack the groceries into the cloth/canvas shopping bags when paying at the checkout counter

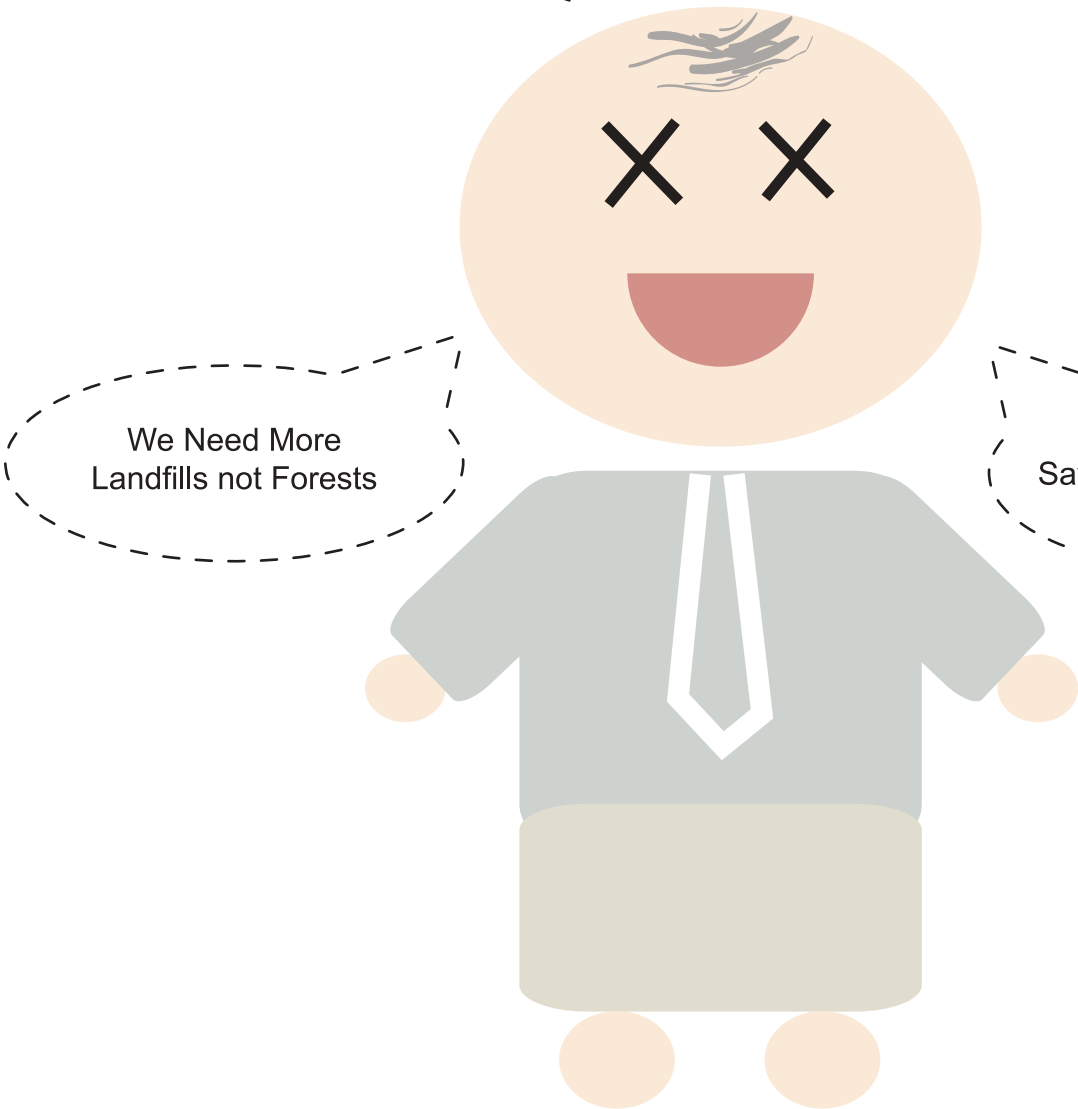
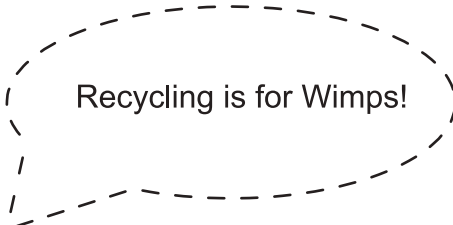
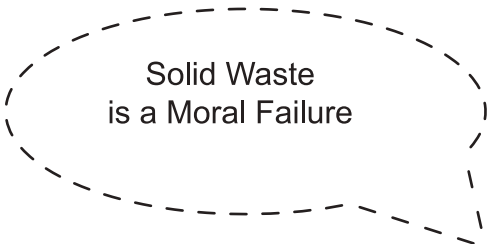
OPTION

A teacher or head of the household can also do all of the above at a night market or pasar malam and a wet market (though this will require bringing your recycled plastic bags and more reusable tupperwares/containers)

ASSIGNMENT 2: DEBATE THE GREEN



With your teacher organize an interschool debate with the various motions:



ASSIGNMENT 3: A PICTURE IS WORTH A THOUSAND WORDS

Here's how:

Organise a photo contest at school or with the Residents' Association themed "Waste". Pictures of waste that make the most impact on our conscience wins. A rough guide for this is as follows:

Set up an organizing committee for the photo contest. One good move is to involve your local Parliament and State Reps, the municipal council as well as the Ministry of Housing and Local Government if possible. NGO involvement can be in an advisory and technical role.

Set up a fundraising committee to raise money via sponsorships or personal donations. Prizes for winners in the form of cameras, camera gear or hardware, holiday vouchers and hampers should also be solicited from relevant companies. Companies can also be partners for better media coverage and resources, plus it can be part of their CSR initiatives.

Advertise the contest in newspapers or via e-mails, facebook and other online social platforms. Partner with the media.

Draw up contest rules and regulations and register each participant.

Invite a panel of judges and set a deadline for the last submission.

Announce the contest winners in newspapers, via e-mail and post.

Set a day for the prize giving ceremony in a school or multipurpose hall. Invite press.



OPTION

In conjunction with World Earth Day on 22 April or World Environment Day on 5 June, discuss with your teacher on organizing a photo competition at school or in your community. The topic of the competition is EcoBloopers. The contestant with the funniest picture(s) of people throwing rubbish or doing funny things with rubbish wins!

MODULE 3

HANDS-ON ACTIVITIES

3.1 4R 2C - HANDS ON ACTIVITIES

3.2 THE ART OF RECYCLING

3.3 COMPOSTING

COMPOSTING FORMULA

COMPOSTABLE MATERIALS

COMPOSTING TECHNIQUE

COMPOST SIZE / VOLUME

COMPOSTING PERIOD

TROUBLESHOOTING

3.4 NATURE CRAFT

3.5 FERMENTED WASTE JUICE-GARBAGE ENZYME



Module 3: Hands - On Activities

In this module, we will explore ideas surrounding the 4R 2C concept in our daily lives. Learn about the art of recycling (which is handling your recyclable items correctly), try your hands at composting, and allow some creative juices to flow with nature arts and crafts.



www.gettyimage.com

3.1 4R2C Hands-on Activities

How can we implement 4R 2C in our daily lives? It's simple! Prevent or minimize waste generation through the rethink, reduce and reuse approach. Then recycle. If it is inorganic waste and recyclables, collect, sort and properly recycle it via the art of recycling concept. If it is organic waste, compost or ferment it. Finally, close the loop – support and demand for new products made from recyclables.

● SMART ways ●



Ways For You To **REDUCE**

- Buy products with little or no packaging.
- Items that you do not use often, try renting them instead of buying them.
- Buy products that are durable and long lasting.
- When you buy something, don't take a plastic bag unless you really need one.
- Find alternative ways to wrap gifts, such as a reusable cloth bag.
- Use a handkerchief instead of tissue.
- Use reusable containers for food instead of plastic bags or Styrofoam.
- Buy rechargeable batteries instead of disposable ones.
- Choose products that come in recyclable or refillable containers.
- Instead of buying your favourite book, magazine or newspaper, go to the library. It is fun and free!
- Use plates, cups and utensils that can be washed rather than the ones that you throw away.

● SMART ways ●



Ways For You To REUSE

- Draw and write at both sides of your paper instead of on one side.
- If an item breaks, try fixing it rather than buying a new one.
- Donate or sell old items instead of throwing them away. That way, someone else can enjoy it too.
- Instead of throwing away old clothes, turn them into cleaning rags.

3.2 The Art of Recycling

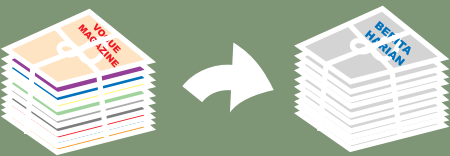
Many may know about recycling, but many may not know “the art of recycling” – the right way to handle recyclable materials before being sent to collection centres. The art of recycling is in fact a convenient way to handle recyclables particularly in terms of storage and cleanliness.

The illustration below will demonstrate what materials can be recycled and the right way to recycle them as well as materials that cannot be recycled.

Magazines, newspaper & books

HOW TO STORE & RECYCLE ?

Tie neatly into bundles



Loose mixed paper

HOW TO STORE & RECYCLE?

Place in a container



Loose white paper

HOW TO STORE & RECYCLE ?

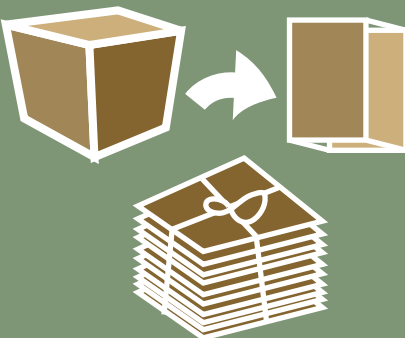
Place in a container



Cardboards: tissue boxes, shoe boxes and other cardboard based boxes

HOW TO STORE & RECYCLE ?

Flatten and tie neatly into bundles



WHAT CAN BE RECYCLED?
1
PAPER

WHAT GENERALLY CANNOT BE RECYCLED?

Pizza boxes or anything soiled with grease and/or food waste

Paper plates

Facial or bathroom tissue

Carbon paper

WHAT CAN BE RECYCLED?

2

PLASTIC

WHAT GENERALLY CANNOT BE RECYCLED?

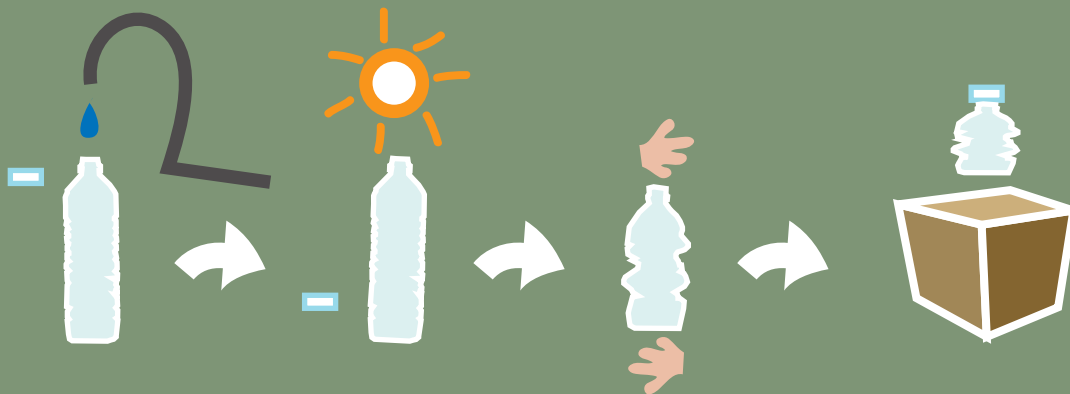
Styrofoam

Plastic container without label number 1, 2, and 4

Clear plastic (PET 1)

HOW TO STORE & RECYCLE ?

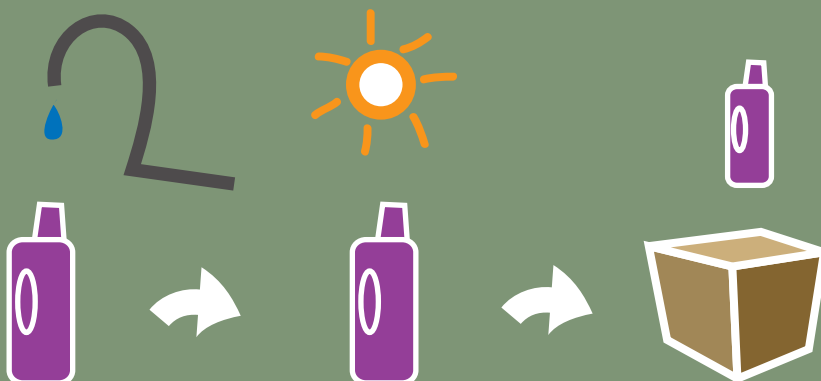
Rinse, dry and crush



Colour plastic (HDPE & LDPE)

HOW TO STORE & RECYCLE ?

Rinse and dry



The technology for recycling styrofoam is currently exist but not in Malaysia. Therefore, it is still best not to buy or use styrofoam to pack food. Styrofoam contains styrene molecules which can leach into your food and disrupt the endocrine system and cause hormonal imbalances. It is also carcinogenic.

WHAT CAN BE RECYCLED?

3

ALUMINIUM CANS

Drinking cans

HOW TO STORE & RECYCLE?

Rinse, dry and crush



WHAT CAN BE RECYCLED?

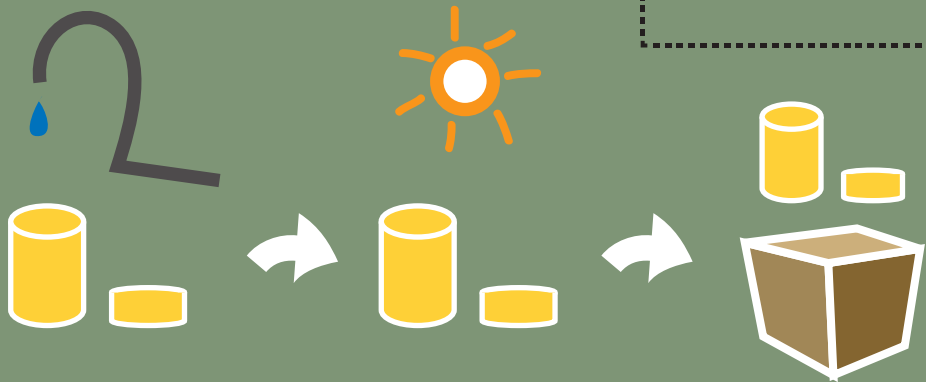
4

METAL TIN & CANS

Condensed milk, sardine, canned food

HOW TO STORE & RECYCLE?

Rinse and dry



WHAT GENERALLY CANNOT BE RECYCLED?

Aerosol cans

Solvent cans

Paint cans

WHAT CAN BE RECYCLED? 5 TETRAPAK

Beverages cartons

HOW TO STORE & RECYCLE?

Rinse, dry, flip, flap and flat



WHAT CAN BE RECYCLED? 6 GLASS

WHAT GENERALLY CANNOT BE RECYCLED?

Ceramics

Drinking glasses

Window glass

Mirrors

Light bulbs

HOW TO STORE & RECYCLE?

All coloured and clear glass, which includes drink bottles, food containers, vitamin bottles and cosmetic jars.

Rinse and dry



3.3 Composting

Composting is nature’s way of recycling organic matter. It is a process whereby; biodegradable organic matter is broken down by microorganisms in the presence of oxygen. The product of this process is compost, which benefits the environment as a natural fertilizer for gardening and farming. By recycling the organic material, valuable nutrients and organic matter are recycled, hence, alleviating the solid waste problem.

3.3.1 Composting Formula

Four key ingredients of composting are brown material, green material, air and water. Green and brown materials are biodegradable organic matter that forms the main ingredient for composting. Green materials are rich in nitrogen and brown materials are rich in carbon. It is important to have a 50:50 ratio by weight of green and brown in a compost pile. Air and water is important for aeration and provide moisture for decomposer organisms. Complete and perfect compost should be friable, cool, dark in colour and exude an earthy smell. Refer to figure 3.2.

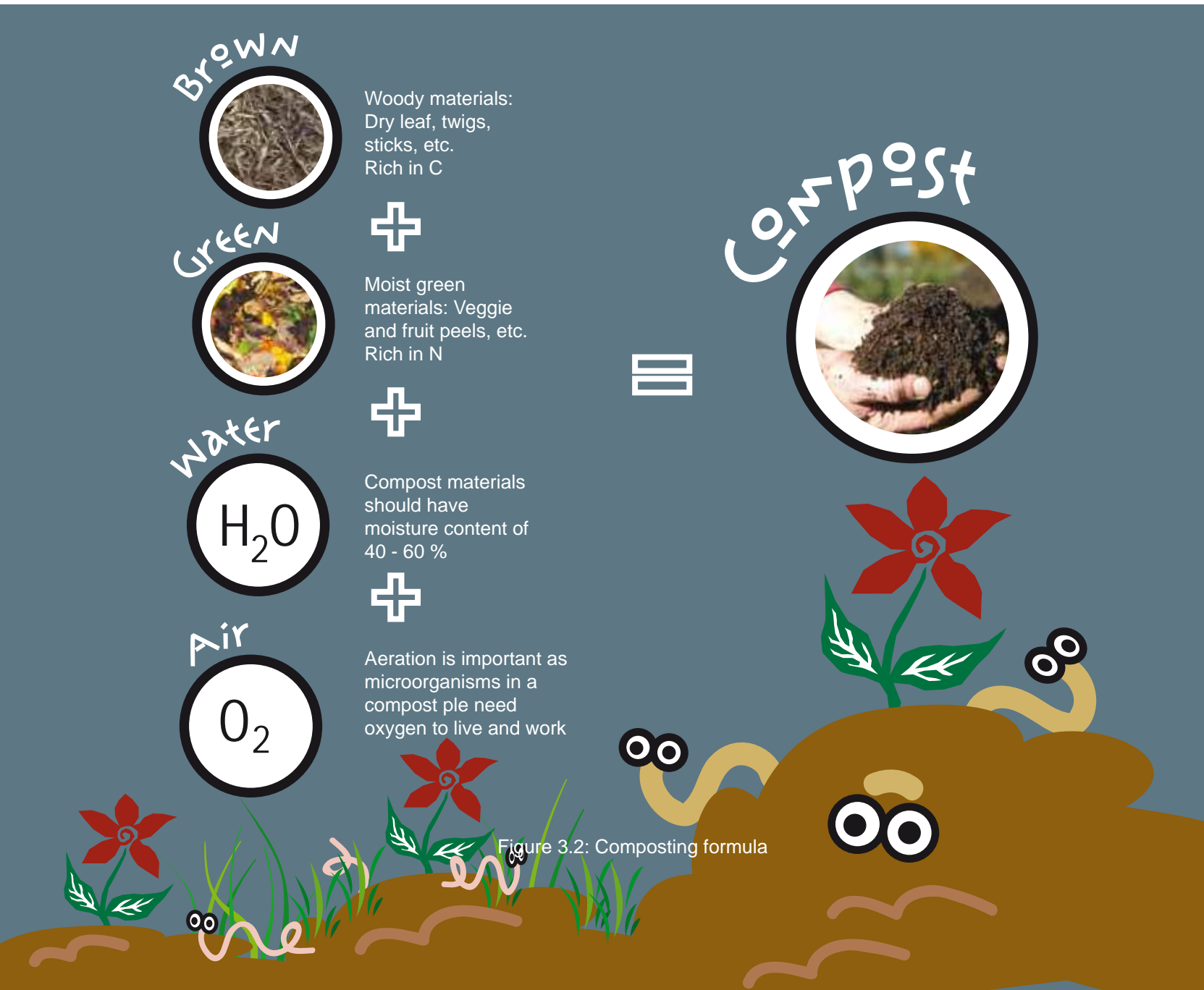


Figure 3.2: Composting formula

3.3.2 Compostable Materials

There are four organic materials which can be used to make compost; green materials, woody materials, household materials and food scraps.

Leaves, grass clippings and weeds are among green materials. Leaves will compost naturally unlike grass clippings. Grass clippings are high in nitrogen and when it biodegrades, it emits a strong ammonia odour if the thin blades of the grass clippings are clumped together. Weeds are another green material that are high in nitrogen. However, it is important to avoid invasive weeds, weeds with vigorous rhizome, and weeds with seeds in your compost pile.

Woody or brown materials are extremely high in carbon; thus, they will take longer to decompose. Nonetheless, decomposition can be aided by chipping or cutting the materials. Examples of woody or dry materials are small twigs, branches, seed pods.

Food scraps such as fruits & vegetables peels, coffee ground, and tea leaves are suitable to be used as compost ingredients. However, meat and dairy food scraps must be avoided because these will attract maggots, flies and other pest.

Household materials such as newspaper, untreated sawdust, corrugated & uncoated cardboard can be used to make compost (newspaper & cardboard should be ripped up into strips and moistened (soaked in water)).

Items to avoid in your compost

- Avoid adding diseased plants into your compost pile
- Avoid adding pesticide treated plants
- Avoid adding food material which have been mixed with meat and dairy
- Never add bone, fat or meat
- Never add fecal waste of pets (disease pathogens)

3.3.3 Composting Technique

There are different techniques that can be used to make compost, however; the principle or process involved is still the same.

The principle is to have alternate layers of brown and green materials that are covered up by soils.



a) Flowering Pot Composting

Materials:

Empty flower pots,
Green & Brown Materials
(fruit & veggie peels, dry
leaves),
Soil,
Water,
Shovel

Method:

Lay a layer of gravel or stones at the bottom of the pot for aeration. Put a layer of soil (about 2 inches) on top of it. Put in green materials and cover loosely with a layer of soil. For the next layer, put in brown materials and cover loosely with a layer of soil. At every layer that is covered up by soil make sure to water it (damp). Do this alternately until the pot is full (figure 3.3) and move to the next pot (figure 3.4). It is important to make sure all holes and crevices are covered with soil to avoid pest and pets from digging up the food.

During the decomposition process, make sure your compost is moist and well aerated. Oxygen is important for your compost in order to avoid the anaerobic process from taking place. Once in a while, try to fork some holes into your compost as this allows aeration. Please note that there should not be any bad odour during the process except for an earthy/natural scent. The compost will be ready for use in 4 to 6 months.

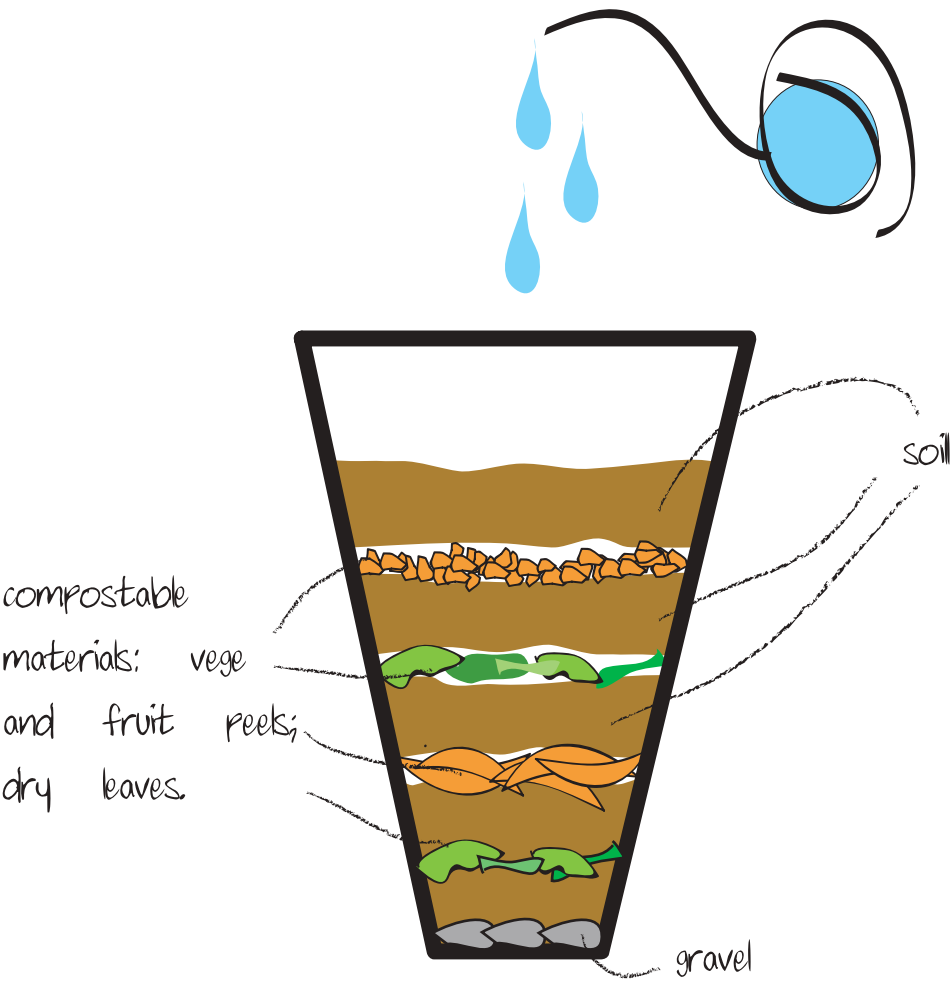
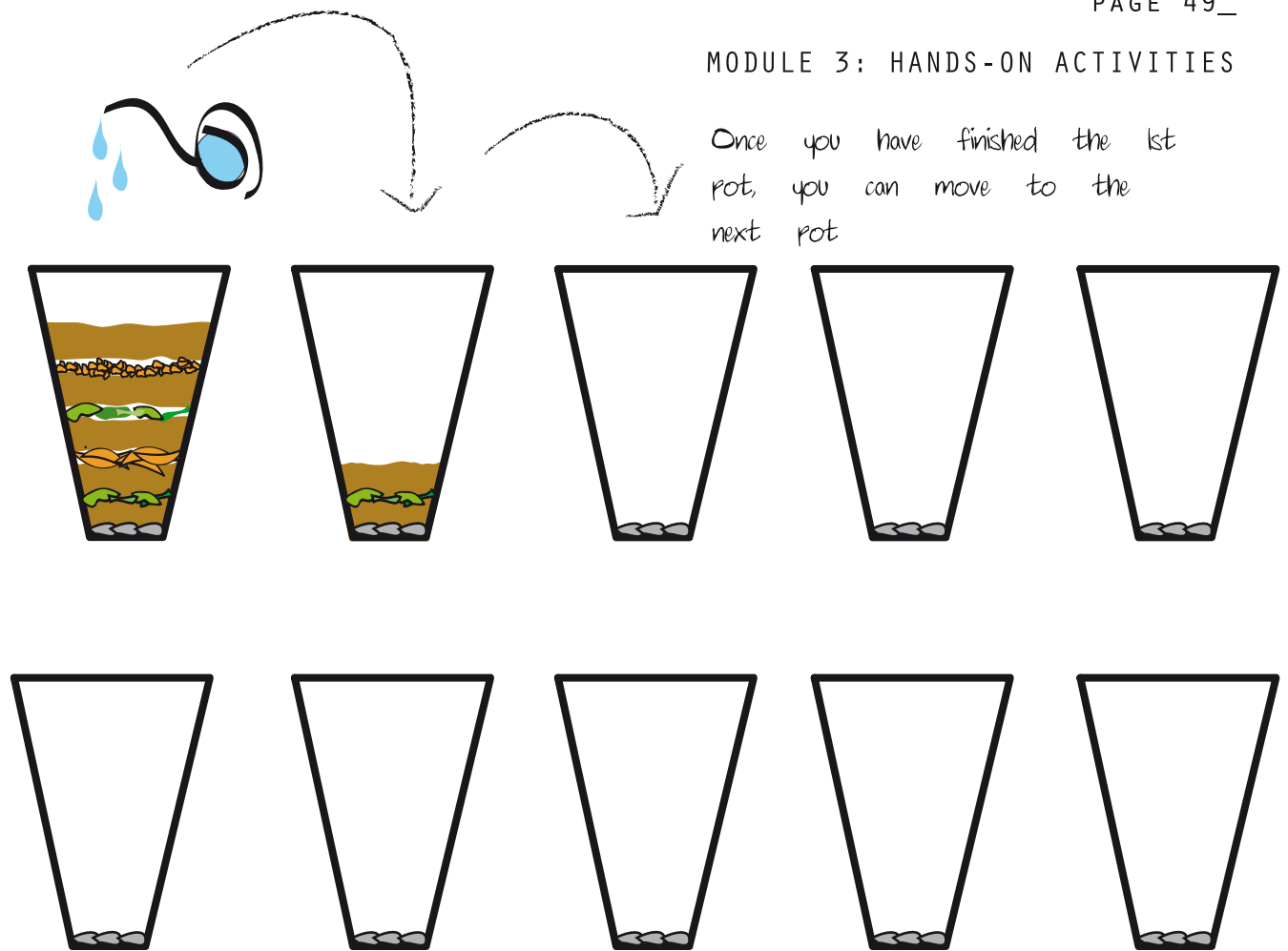


Figure 3.3: Flowering pot composting technique

MODULE 3: HANDS-ON ACTIVITIES



After the 10th pot (about 4 to 6 months) , your 1st composting pot can be used as fertilizer (depends on the type of compost materials you use)

Figure 3.3: Ten pot system

b) Compost Pit

Materials:

Small branches or twigs,
Kitchen waste or food scraps,
Hollow tube with holes,
Soil,
Water,
Shovel

Method:

Dig two pits (3ft x 3ft x 3ft). The pits should be situated in a place exposed to sun and air. Put small twigs at the bottom and place a hollow tube for air circulation. Place the kitchen waste or food scraps into the pit and cover with sufficient soil to ensure that no odour comes out from the pits. If a single fly is seen hovering around the pit, add more soil to cover the food scraps. Do not compact the soil but allow it to loosely cover the content of the pit and ensure that the soil adequately covers the kitchen waste. Keep compost pit moist and

moderately wet. Repeat the process until the pit is full. Move to the second pit while waiting for the first pit to be decomposed. During heavy rain, cover the pit with a piece of wood or plastic to prevent too much water from entering it. Decomposition will take place within 3 to 4 weeks for small pits and 3 to 4 months for big pits. To test if the compost is done, scoop a little portion from the top of the pit and if no foul odour emanates from it, decomposition is complete and it is ready for use.

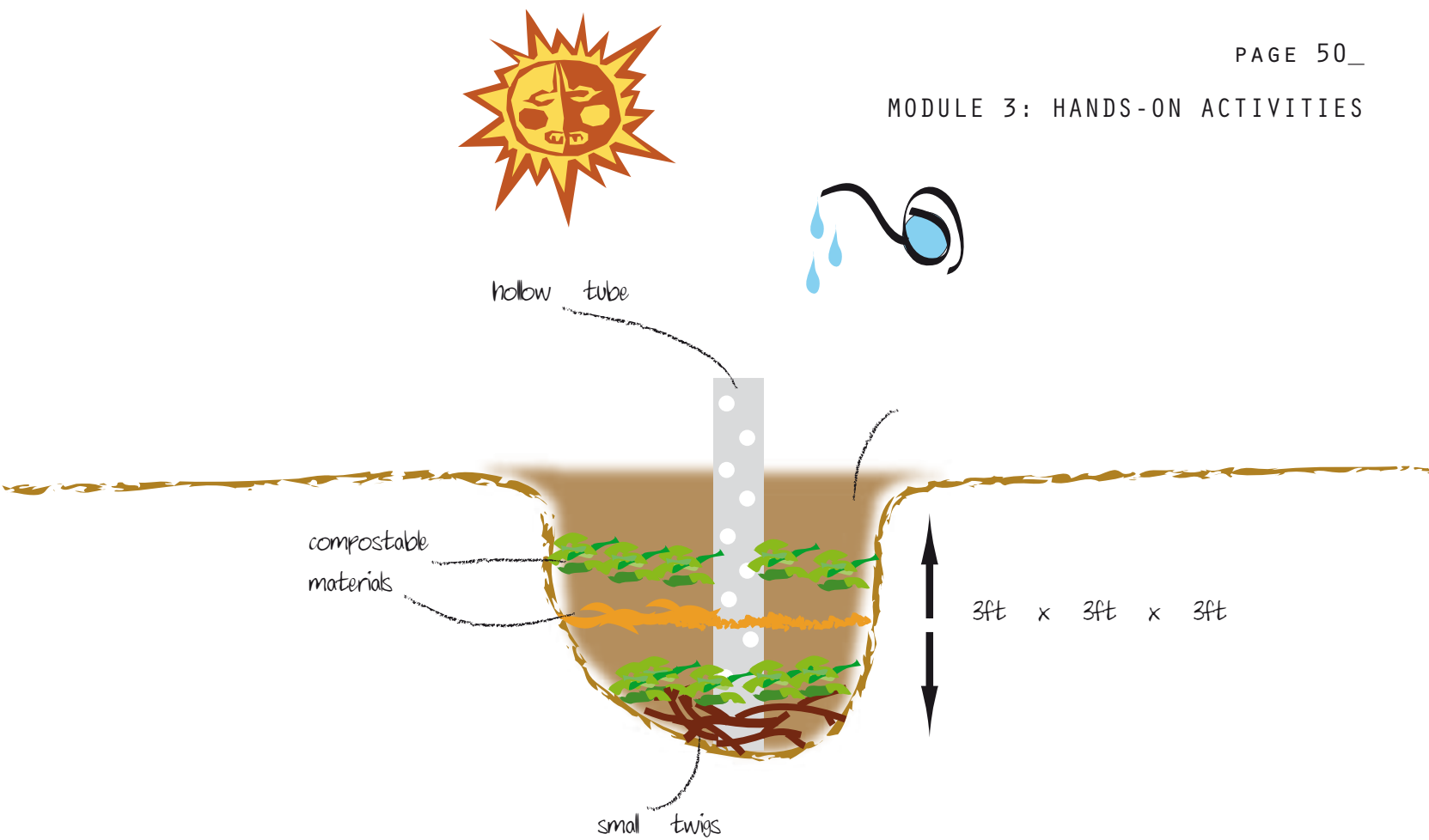


Figure 3.4: Compost pit

c) Plastic bag composting

Materials:

- Empty plastic bags,
- Brown materials (dry leaves, twigs),
- Soil

Method:

Punch hole in plastic bags (for aeration). Put a layer of soil at the bottom and alternate your brown materials until it is full. Tie the bags neatly and hang with hooks on fences or stacked up neatly. Remember to keep contents moist. Compost will be ready for use in 4 -5 weeks.

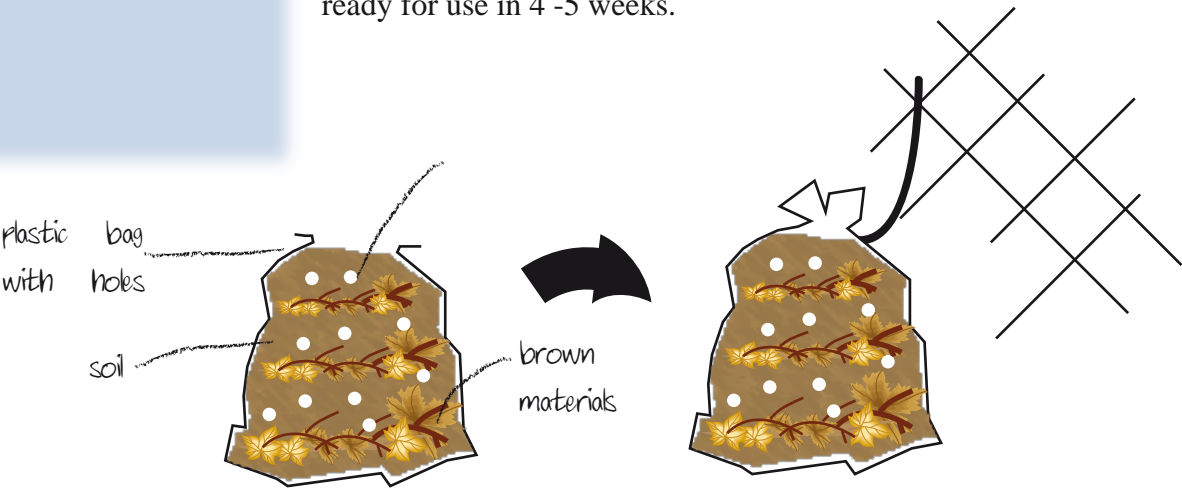


Figure 3.4: Plastic bag composting

3.3.4 Compost size/volume

Preferable size is 3 ft x 3 ft x 3 ft as this is the perfect size to retain heat while still allowing air flow. It is also manageable to turn regularly. A smaller volume than 3 ft cubed will have trouble holding heat whereas a bigger volume than 5 ft cubed won't allow enough air to reach microbes.

3.3.5 Composting Period

The composting period or rates vary depending on the type of materials used as well as any additional activators involved to hasten the decomposition process. For instance, traditional composting takes about 3 to 6 months, whereas if an activator is used in composting (aid of fungus activator *Trichoderma harzianum*) it only takes about 3 to 4 weeks. Composting using EM (Effective Microorganism) (eg: EM Bokashi) only takes a month and a half. Vermicompost, using worms takes 2 to 3 months.

3.3.6 Troubleshooting

Problems	Causes	Solutions
Bad Odour	Uncovered or improperly used food scraps	Remove & discard any improper materials (meat, dairy, etc); bury materials under 1 ft or more.
	Anaerobic pile	Turn materials, mix dry leaves. Check base of pile for proper drainage.
	Too much grass	Mix grass with other dry or high carbon materials or remove some grass, spread out to dry and mix back into pile.
Insect pest	Too dry, not mixed properly	Make sure food materials are properly buried, and turn outer layer of materials into core of pile. Hot piles will destroy or deter most insects, such as grubs and other larvae (maggots). Moisten pile if necessary; moist piles deter bees and wasps. Use caution when taking wood chips and woody material from potential termite and carpenter ant sources such as rotted wood piles or municipal mulch piles.

Problems	Causes	Solutions
Animal Pests	Improper food handling	Most animals are deterred by burying food under other materials. For persistent problems, especially with rodents, stop adding food, use an enclosed bin, or change bin design to restrict access. A secure lid will discourage most possums, raccoons, and birds.
Pile not breaking down	Insufficient nitrogen	Add grass, manure, kitchen scraps or other natural nitrogen source.
	Pile is too dry	Add water while turning until moist, not wet. It should feel like a sponge throughout.
	Poor aeration	Start turning and mixing materials more often; check integrity of base, replace if broken down.
Pile heats up, then stops	Poor aeration	Hot piles need lots of fresh oxygen: turn materials as pile starts to cool down. It might be necessary to add an additional nitrogen source periodically.
Pile is slightly warm in the middle	Too small	Piles require a certain critical mass (approximately 18-20 cubic feet) to work efficiently. Add more materials if possible, or use a smaller bin to concentrate the pile's volume.

3.4 Nature Craft

Nature craft is craft that is made from reusable materials. These can be waste materials that you can easily source from your compound. Using waste materials to make craft is not only an excellent way to recycle, it is also a good way to teach or learn about waste reduction.



Why should we make nature craft from waste materials?

Save money!

You will learn about recycling, reducing and reusing waste materials.

It will be good for preserving our environment.

Challenge your creativity in making a new craft.

It can be a creative gift for yourself and your friends.

What can be used for making Nature Craft?

Fabrics, Ribbons, Bows, Buttons, Beads, Bottle Caps, Plastic Water Bottles, Aluminum Cans, Old Greeting Cards, Newspapers, Magazines, Rocks, Leaves, Fallen or Dried Flowers, Packaging From Light Bulbs or Other Boxes, Ticket Stubs, Post-Cards, Seashells, Carpet Squares, Shoeboxes, Styro-foam Packaging Materials, Egg Cartons, Paper Shopping Bags, Tin Cans, Plastic Containers

D.I.Y NATURE CRAFT:**1****Recycled Calendar Envelopes**

Turn outdated calendars into beautiful envelopes. It's easy!

Source: http://www.makingfriends.com/calendar_env.htm

YOU NEED:

A large outdated calendar with scenes printed on letter sized paper

Envelope Template (refer to page 55 for the template size)

Glue Stick

HERE'S HOW:

Cut apart the calendar at binding. Draw Envelope Template on another page of calendar. Cut on the solid lines. Fold on the dotted lines so picture is on the outside. Glue the two side flaps to the bottom flap at overlap. Glue the top flap after you have inserted your letter.

**2****Pringles Pencil Keeper**

Source: <http://crafts.kaboose.com/pringles-pencil-keeper.html>

**WHAT YOU NEED:**

Small Pringles can

Small Pringles can lid, optional

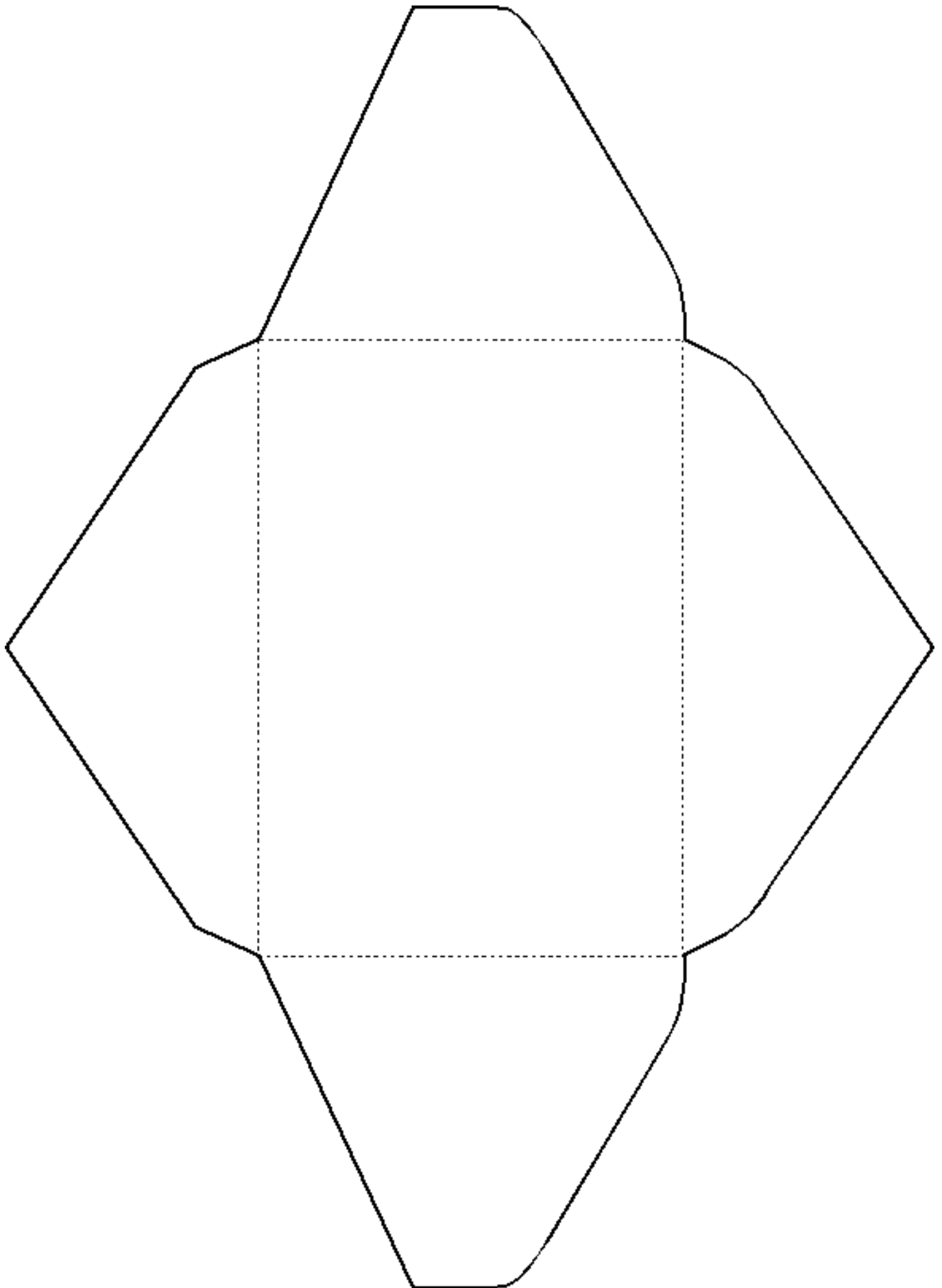
Gift wrap, construction paper, book cover material, or decorative Con-Tact paper

Double stick tape or glue

Scissors

HERE'S HOW:

We wrap the outside with gift wrap, construction paper or the Con-Tact paper or book cover. Cut to size and adhere to the Pringles can with double stick tape or glue. Punch holes in the lid if you want your pencils to stay in place. Use this decorative pencil holder on your desk at school, at home, by the phone, or any place you may need to have pencils and pens handy.



D.I.Y NATURE CRAFT:**3****Gift bags made from recycled envelopes****YOU NEED:**

Reused / recycled envelope

Scissors & Double sided tape

Ribbon

Hole puncher

**HERE'S HOW:**source: <http://www.care2.com/greenliving/diy-gift-bags-made-from-recycled-envelopes>

Cut off one end of the envelope.

Fold one side in towards the center (maybe about an inch or slightly less). Do the same with the other side, then fold the bottom up by the same amount, making creases in the paper.

Put the bag over one hand. Use your other hand to shape a flat bottom for your bag, pushing the bottom center crease downward, causing the side folds to buckle out. Crease the corners of the bottom into triangles.

Use a bit of double-sided tape to stick the corner triangle flaps to the bottom of the bag.

Reverse the folds along the sides of the bag to give it shape.

If you like, punch holes and thread ribbon through for a handle.

4**Egg carton heart shaped frame****YOU NEED:**

One egg carton - not the Styrofoam kind nor the plastic ones (cut and use only the bottoms of the egg carton)

Red paint

Background card stock

HERE'S HOW:

Cut the bottom 3/4" of each egg holder. Paint and glue them on a card stock. When everything is dry, paint the spaces between the cut egg holders.

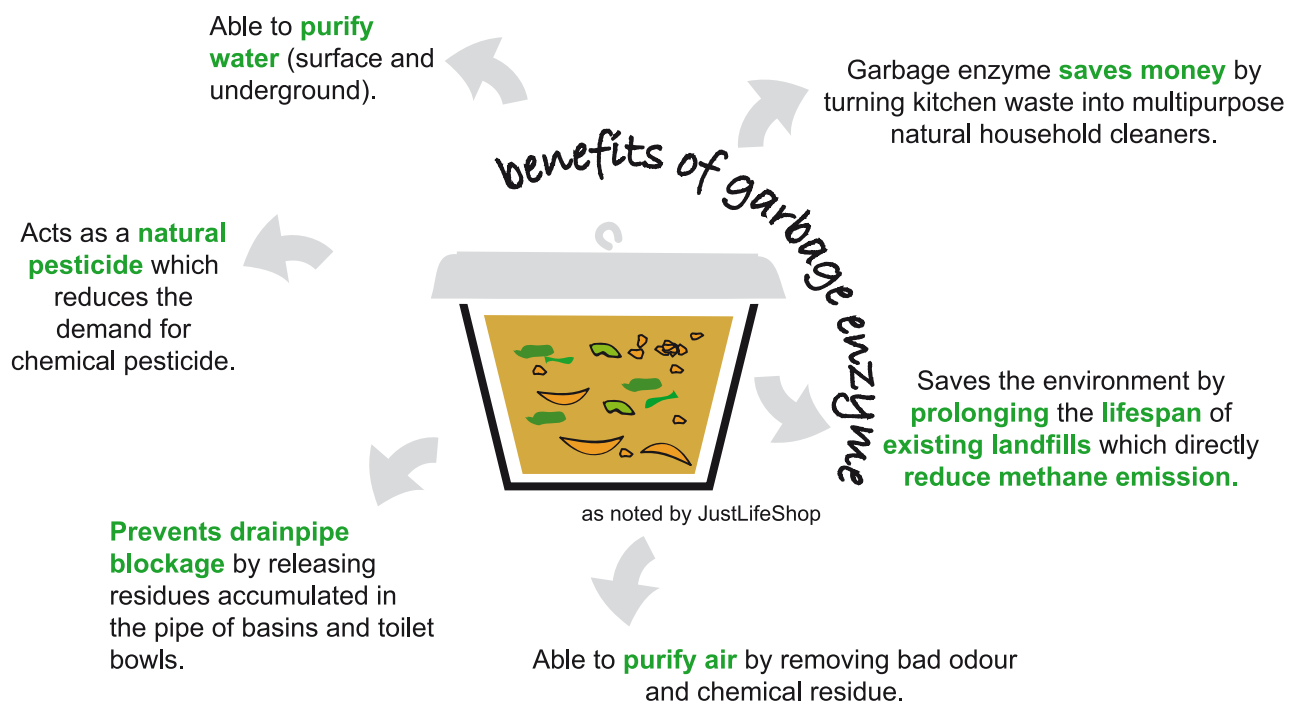
source: <http://alittlehut.blogspot.com>

3.5 Fermented Waste Juice – Garbage enzyme.

Another method of turning organic waste into something valuable is by converting organic waste into fermented waste juice, also known as garbage enzyme. Garbage enzyme was developed by Dr Rosukon, who hails from Thailand. Garbage enzyme is a multipurpose solution for households, the environment and agriculture. For agriculture, garbage enzyme is used as organic fertilizer and organic pesticide. For households, garbage enzyme is used as a cleaning liquid to remove oil and grease in the kitchen and remove dirt and odour in the toilet. It is also used as an organic pesticide and cleanses the air.



shafinaz / GEC
Fermented fruit juice



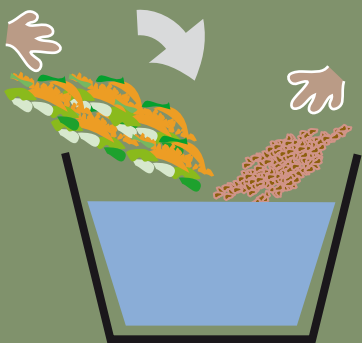
Materials and ingredients:



Formula:

A ratio of 1:3:10 for sugar: vegetables/fruits waste: water respectively is needed to produce garbage enzyme.

Method:



Use an air-tight plastic container. Dilute 1 ratio of brown sugar, followed by 3 ratio of fruit and vegetable waste into 10 ratio of water.



Make sure some space is left in the container for the fermentation process. Close the container tightly. Within the first month of the fermentation process allow some gas to be released to avoid pressure build up in the container. Once in a while stir and push the floating garbage downwards.



Place the container in a cool, dry, well ventilated area and avoid sunlight. The enzyme is ready to be used after 3 months and it should have a dark brown colour.

Point to be noted and taken!

Preferably use a container that can be expanded.

Only use fruit and vegetable waste. Avoid oily cooked food, fish and meat waste.

If the colour of garbage enzyme is black, add in the same amount of sugar and start the fermentation process again.

Fully utilize the garbage enzyme residue by reusing it for the next production by adding fresh garbage, use as fertilizer by drying the residue, blend it and bury it, grind the residue, pour into toilet bowl, or add some brown sugar and flush to help purify the sewage.

The longer the enzyme ferments; the better it is and the best part is, it never expires!

Never store the garbage enzyme in a fridge.

ASSIGNMENTS

adopt an organic farm
school composting project
craft from recyclable materials
set up a school herbal garden and
orchard



ASSIGNMENT 1: ADOPT AN ORGANIC FARM

Here's how:

Contact a nearby organic farm that works with and trains communities and students on organic farming

The public and students can adopt a plot for a token sum to plant vegetables and herbs

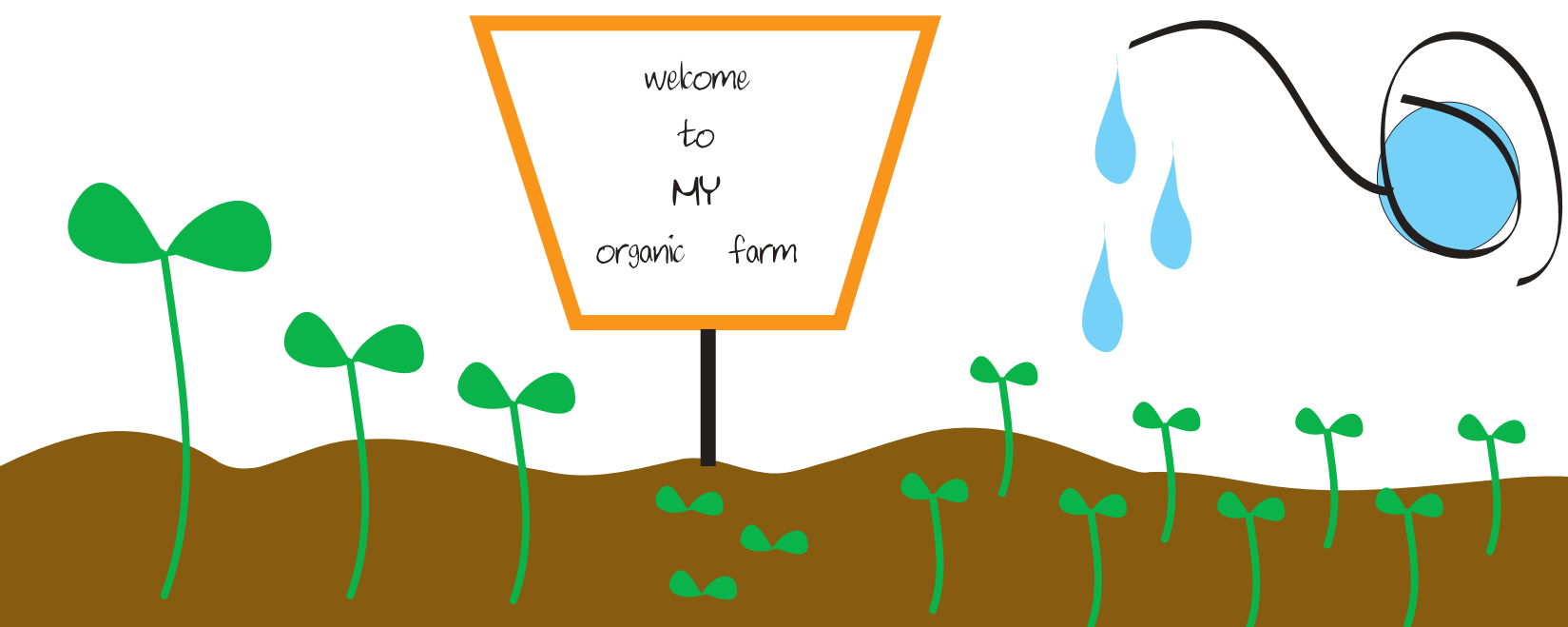
Work on the farm such as weeding, fertilising with compost and watering the plot can be done on a weekends only basis or on a bi-monthly work schedule

You can make your own compost at the farm by collecting kitchen waste from home, the community or school. Use this compost to fertilise your plot

Training on organic agriculture methods can be arranged with the farm manager

At the end of the planting cycle, vegetables and herbs from the plot can be harvested and distributed among family and friends or students in a school

Option: After the project is completed and you are still interested in working at the farm, you can sign up as a volunteer to help during your free time.



ASSIGNMENT 2: SCHOOL COMPOSTING PROJECT

Here's how:

Get the permission of the school principal for this project as some land is needed as a site for composting.

Arrange with the canteen management to send their uncooked waste to the composting facility

Arrange with the school gardener to send garden waste to the composting facility

Arrange with the households in the community to send in their kitchen waste that can be composted. Designate two days a week for collection.

Make sure the compost heap is maintained as in the guide in Module 3.

Draw up a task schedule that assigns a team of students to maintain the compost heap on a rotational basis

When the compost is ready, arrange with the gardener to use it for the school garden

Alternatively, the respective households in the community can also buy the compost for a token sum. This is especially convenient when the school has a surplus of compost.

Money from the sales can go towards repairs in the school or buying more books for the library, etc.



ASSIGNMENT 3: CRAFT FROM RECYCLABLE MATERIAL

Here's how:

Collect recyclable materials such as old clothes, aluminium cans, magazines, and such.

Refer to Nature Craft tips on page ?? for ideas on how you can make nice things out of old stuff.



ASSIGNMENT 4: SET UP A SCHOOL HERBAL GARDEN & ORCHARD

Here's how:



source: Sekolah Menengah Sri Bestari

Discuss with your principal to reserve a plot of land in the school for a herbal garden & orchard.

With the help of teachers and parents, organise a bake fest, art fest or collect and sell recyclables to raise funds to buy gardening tools, seeds, and tree saplings.

For fertilizing the soil, start a compost heap at school using the guidelines from Module 3.

Hoe the soil and mix in the compost if the soil is naturally infertile. Maintain the compost heap for future use.

Plant the herbs and fruit trees.

Draw up a work schedule for maintenance of the garden on a regular rotational basis.

All waste from the garden (grass cuttings, rotten fruits, etc) can be plied into the compost heap which is then used to fertilize the garden soil, thus completing a cycle.

Compost and harvest from the herbal garden can be sold to nurseries, households and restaurants in the neighbourhood as well as donated to charities.

All proceeds from sales can be plied back into the garden's upkeep or school repairs and upgrades.



MODULE 4

THE NEXT STEP

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Module 4: The Next Step

4.1 How to Initiate a Zero Waste System



After knowing, understanding the causes and effects of solid waste problem and what can be done, this part consist of guidelines on how to establish a zero waste system at a local level.

INITIATE A PROPOSAL

Initiate a proposal to conduct a recycling programme in your school/organization.

Your proposal should include:

- a) an introduction
- b) problems & issues
- c) objective(s)
- d) method to conduct the programme
- e) expected budget
- f) expected outcome/benefits

Submit your proposal to the top-level management for support!!



GET SUPPORT FROM YOUR TOP LEVEL MANAGEMENT

Most of the time, the success of your zero waste programme depends upon the endorsement of your management leader. So make sure you are fully committed to the programme and allocate some time for yourself as well as for your team to ensure that the zero waste programme is approved.

This is important because;

- Positive attitude from them will help to promote similar attitude among your colleagues and others
- The zero waste programme often requires some capital. Approval of your programme will likely depend on some available resources where necessary
- This will ease the implementation of your zero waste programme.



FORM A RECYCLING TEAM/COMMITTEE

Once your proposal has been approved, form a support group which has been trained (eg: SMART Ranger trainer). The team must be represented by every level in the school / organization (at least 1-2 people from every level/unit). This action will help ensure the continuation of the programme and development as well as play an important role in building capacity and awareness.

APPOINT A COORDINATOR

Appoint a coordinator to manage the entire zero waste programme in your school or organization. The person selected must have ample knowledge of recycling & must be genuinely interested & passionate about zero waste activities.



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EXECUTION OF ZERO WASTE ACTIVITIES

a) Waste Assessment

Waste assessment will help you to get a vivid picture of waste composition in your school or organization. It will help you to identify measures or steps that you can take to reduce your waste and applies the concept of 4R2C. This assessment is called a Waste Audit.

How to Conduct a Waste Audit

- i) First, identify areas where waste/trash originates or distinct areas where waste is generated. For example, cafeteria/canteen, storage room, toilets.
- ii) Then create your own waste audit form. An example of the form is shown below.

WASTE AUDIT FORM				
LOCATION:				
WEIGHT OF WASTE:				
MATERIALS	RECYCLABLE (Y/N)	WEIGHT	%	COMMENTS/REMARKS
Newspaper				
Magazine				
Alumunium Cans				
Plastic Bottles				
Glass				
Tetrapak				
Food Scraps				
Others				

iii) Using the audit form, record where the waste/garbage was collected from (canteen, storage room).

iv) Then weigh the garbage bag.



- v) Following that empty the contents of the garbage bag and start sorting the waste into categories (paper, can, bottle, tetrapak)
- vi) Record the weight of each sorted item and get the percentage
- vii) Complete the calculation on the form
- viii) Use the percentage or numbers to chart or graph your organization's waste
- ix) Calculate Carbon Footprint

How to calculate?

Solid waste contribute to carbon emission through embodied energy of the waste materials and through methane production in landfill.

There are so many ways to calculate the carbon dioxide emission from waste which varies to country and type of waste. For the SMART Ranger programme, the following formula is adopted:

$$1 \text{ kg of Municipal Solid Waste (MSW)} = 2.69 \text{ of Carbon Dioxide emission}$$

Therefore, to calculate the amount of carbon dioxide emission from your school waste is as follows;

$$\boxed{} \text{ kg of your school MSW} \times 2.69 = \boxed{} \text{ of carbon dioxide emission}$$

note: the amount that you gain from the calculation will be your school's carbon footprint before execution of waste reduction plan.

- x) Finally, Create A Waste Reduction Plan

b) Waste Prevention/Minimization Plan

The next step after a waste audit is the identification of waste prevention/minimization opportunities. Remember what you have learnt - 4R2C. For instance, keep used paper for notes & rough drafts, use reusable drinking container instead of styrofoam cups, explore the possibility of using durable products such as handkerchieves instead of disposable napkins.

c) Designing an Internal Collection System

It is important to design a method of collecting recyclables among your school mates or colleagues. The important part is that the collection system must be convenient.

Here are some considerations;



The options of recycling and organic waste containers can range from reused boxes to commercially available recycling bins.

The containers can be placed per department and per individual. Consider the quantity, size and shape of the containers. These must not be too large or bulky as they need to fit in the allocated space.

The containers must be labelled to inform all users what to put in and what to leave out.



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d)Storage

The central storage area must be clean, dry, and free from fire hazards and must not attract pests.

If the storage is outside of a building or room, please consider using covered bins as this will preserve its contents and prevent litter.



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e) Collection Schedule

Create a collection schedule/duty roster and assign members of the group. As for composting, make sure the collection schedule is adhered to as often as possible, the best is every day to keep away vermin and other animals as well as to avoid bad odour because organic matter rots easily.



f) Composting site

Select a suitable site for composting activities.

Create a duty roster and assign members to compost the organic waste through the selected technique.



g) Materials Preparation (Art Of Recycling)

Some of the materials require special preparation for efficient transportation and to reduce space consumption.

Encourage your members/schoolmates to practice the art of recycling.



h) Collection System

Design a collection system and determine if the recycled items will be collected separately or together.

Decide who will collect the materials, how often this will be and where will the items be stored?



Set a consignment date for the vendor to collect the recyclables.

g) Offsetting Carbon Emission With Tree Planting

By reducing waste generation, recycling and composting, the school will be helping to reduce their carbon footprint. By using less and creating less waste, they will be helping to reduce the demand and production of items which means reducing greenhouse gas emissions from factories, transport vehicles and waste decomposition in landfills. There will also be less water, land and air pollution. Recycling also means that fewer natural resources will be used to produce new products so less energy is required.

Tree planting activities will offset carbon emissions and produce a better environment for schools because trees absorb carbon dioxide during photosynthesis.

How to Offset Carbon Emission through Tree Planting?

i) After implementing waste reduction plans; repeat the steps of i to xi from how to conduct waste audit. The amount that you gain from the calculation will be your school's carbon footprint after the execution of a waste reduction plan.

ii) To calculate the remaining waste, the following formula is used;

$$\begin{array}{ccccc} \boxed{} & - & \boxed{} & = & \boxed{} \\ \text{carbon footprint before} & & \text{carbon footprint after waste} & & \text{the amount of carbon} \\ \text{waste reduction plan} & & \text{reduction plan} & & \text{dioxide left from waste that} \\ & & & & \text{cannot be recycle/compost} \\ & & & & \text{by any means} \end{array}$$

The amount of carbon dioxide left from waste that cannot be recycle/compost by any means will be offset through tree planting.

iii) To calculate how many trees to be plant in order to offset the emission, the following assumption is adopted;



Absorb 800 kgs of carbon for 40 years of its lifespan.
Therefore, one year one tree will absorb 20kgs.

An example: How many trees would you need to offset 6000 kgs of emission?

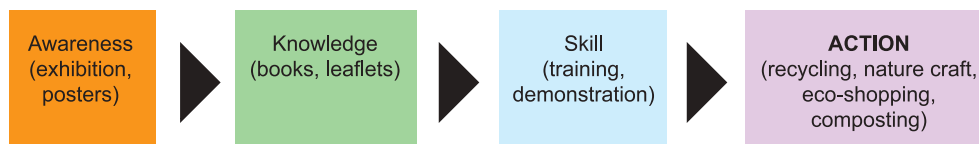
Answer:

- a) 1 year offset = $6000 / 20 = 300$ trees need to be plant.
- b) 10 year offset = $6000 / (20 \times 10) = 30$ trees need to be plant.
- c) 40 year offset = $6000 / (20 \times 40) = 7.5$ trees need to be plant.

(Assuming there is no mortality. If there is; you would have to replant the tree)

EDUCATION AND PROMOTION: THE SCIENCE CIVIC APPROACH

Create awareness via posters, talks, notice boards, exhibitions, display tables/shelves. Spread the knowledge of recycling through brochures, newsletters, and fliers, as well as post it on the website/blog, and circulate via e-mail. Provide 15 minutes of demonstration on the 4R 2C concept (eg: recess time or during assembly). Inform your other friends and families about your zero waste project goals and activities. Encourage participation via conducting interactive and fun activities during leisure hours. Publicize your programme success to maintain ongoing participation via newsletters, flyers, blogs, posters, exhibitions, etc. Conduct training on zero waste training programmes for other schools or community groups/ organizations and ask for feedback to further improve.



MONITORING AND EVALUATION

Always monitor and evaluate the programme to ensure its effectiveness and efficiency.

You can evaluate via the reduced percentage of waste generated and materials recycled through nature craft, recycling, composting and production of garbage enzyme.

Always think out of the box to improve the programme.



ASSIGNMENTS

green audit at school
community recycling
recycling bank



ASSIGNMENT 1: GREEN AUDIT AT SCHOOL



Area in the home	4Rs 2Cs	Tick if Yes
Canteen	Paper towel not used	<input type="checkbox"/>
	Kitchen waste such as fruit peels and vegetable scraps are composted	<input type="checkbox"/>
	Cooking oil, especially for deep frying is used sparingly	<input type="checkbox"/>
Toilets	Chlorox, bleach and whiteners are not used	<input type="checkbox"/>
	Aluminium cans and tetrapak cartons are collected in recycling bins provided in school	<input type="checkbox"/>
	Toilet paper	<input type="checkbox"/>
	Chlorox, bleach and whiteners are not used	<input type="checkbox"/>
	Products containing acid for getting rid of stains on walls and floors are not used	<input type="checkbox"/>
Garden	Chemical fertiliser is banned	<input type="checkbox"/>
	Organic fertilizer or compost is used	<input type="checkbox"/>
	Garden waste is composted	<input type="checkbox"/>
	No herbicide	<input type="checkbox"/>
	No pesticide	<input type="checkbox"/>
	No weedkiller	<input type="checkbox"/>
Classroom and offices	Old batteries are collected and sent to the recycler	<input type="checkbox"/>
	Old computers and printers are recycled	<input type="checkbox"/>
	Broken furniture (tables and chairs) are repaired or recycled	<input type="checkbox"/>
	Paper is printed on both sides before it is recycled	<input type="checkbox"/>
	Printer ink cartridges are recycled	<input type="checkbox"/>

If you ticked YES to more than 10 items on the list, you and your school are definitely helping to save the environment.

You can keep the momentum going by organizing competitions at school to see which class recycled the most or designate a recycling festival with the community within and outside school.

If your school is not doing most of the environment-friendly activity on the list, talk to the principal and start small by doing one or two activities on the list and gradually building up to more on the list.

ASSIGNMENT 2: COMMUNITY RECYCLING

Here's how:

1) Working with your Residents Association or school, set up a community recycling centre at a school or multipurpose hall in your residential area.

2) Designate one weekend per month for collection.

3) The Recycling Centre must cater to a wide range of waste such as:

Collection bins for old batteries and handphones

Collection bins for old light bulbs and fluorescent lamps

Collection bins for old electrical items such as TV, computer, DVD player, etc

Collection bins for old furniture, toys, books, clothes, etc

3) Send out e-flyers and notes to homes to alert the residents of the new Community Recycling Centre. Also make self-made signages to be pasted along the neighbourhood for more publicity.

4) Partner with organizations to sell the collected recyclables/old goods to them.

Examples of recycling organizations are:

Option 1 : One of the **next steps** after the Community Recycling Centre has made a collection is to have a **jumble sale to sell goods that can be reused/recycled**.

Option 2 : You can also **send** your **recyclables** to **Alam Flora pick up counters** or at **any other recycling vendors available**.



ASSIGNMENT 3: RECYCLING BANK ACCOUNT

Here's how:

Set up a Recycling Bank Account in your school under the Smart Ranger Programme. Once you have registered, each student in your school will receive a small "bank account" booklet which will be signed and verified by the school principal.

The booklet will be a record of the amount of waste you send in for recycling and the money to be paid for recyclables according to weight in kilogramme. This will be verified, stamped and verified by your teacher in charge of the Smart Ranger Programme. Upon sale of the collected recyclables to a vendor, the teacher will refer to the "bank account" booklet and reimburse the monies due according to the value of the recyclables, in weight, that you have handed in earlier.

Terms and conditions of the Recycling Bank Account

- The "bank account" booklet cannot be transferred to another holder.
- All transactions must be made in person and not a representative.
- The Bank will not be held accountable for any loss caused by the carelessness of the account holder whereby another person has withdrawn the account money with the book.
- The account holder must report in writing the loss or destruction of the bank book to the Smart Programme Teacher.
- If the bank book is destroyed or torn, it will be replaced with a new book at a fee of RM3 for the first time and RM6 for the second time and subsequent replacements.
- While we aim to give you a fair price, any rise or drop in the price of recyclables cannot be negotiated.



SOLID WASTE MANAGEMENT PROGRAMME

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SMART Ranger Modules

rethink.reduce.reuse.recycle.compost.close the loop

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