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University of Applied Sciences

Design a Solid Waste Management Course for Primary School focus on Reduce-Reuse-Recycle

Project: WastED – Export of Education, Waste Management

Target market: Vietnam

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Bachelor's Thesis

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Abstract

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Title of report Design a Solid Waste Management Course for Primary School focus on Reduce-Reuse-Recycle Project: WastED – Export of Education, Waste Management Target market: Vietnam	**Number of report pages and attachment pages** 54 + 42
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This product-oriented Bachelor's thesis looks at waste-management education in primary schools. The primary objective of the study was to design a basic waste-management course, concisely packed in a booklet, ready-to-use for teachers and trainers. The outcome of the thesis, the booklet (content of the course) is expected to be used as one of the materials for the WastED project – Export of Education in Waste Management.

The study is made up of theory sections and a product design section.
The theory sections carry two themes: primary pedagogy and waste management. The primary pedagogy theme focuses on creative teaching methods including group work and play & learn. The waste management theme covers the reverse logistics theory, discusses the basic definition of waste and reverse concepts, waste classification, 3Rs of reduce-reuse-recycle, especially the four most common recycle materials.

The product design section deals with creating the content and basic design of the product. The study as well as product creation was mostly based on secondary research. The qualitative method was used for the purpose of collecting feedback and improvement suggestion for the product. Five local primary teachers were interviewed.

The aimed output of the thesis, a waste-management course booklet, was created. According to target users, the booklet has met the content requirement in terms of providing practical information and detailed course guidelines. However, it needs further development to be a completed product. The applicability of the product depends on specific cases due to obstacles in the waste-management infrastructure of the applying regions. The WastED Project, as the commissioning party, benefits from this thesis through the waste-management course booklet, used as a ready-made material in exporting waste-management education to other markets.

Keywords
Reuse, reduce, recycle, reverse logistics, waste management, waste sorting, waste collecting, children, teaching, primary education, primary pedagogy

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1 Introduction

This chapter gives reader an overview of the thesis. It starts with background of the study: explain the reason for choosing the topic, purpose and expected output of the thesis; then respectively followed by project objective, project tasks and key concepts. Demarcation of the thesis in terms of running the project and literature review will be covered in Scope of the thesis. This chapter also points out potential benefits for related stakeholders and briefly introduces the case company as well as the thesis's structure.

1.1 Background of the study

Population growths, economic development, increas in good consumption and so on, have put pressure on natural resources as well as waste management. Along with the development of the society, quantity as well as complexity of waste has dramatically increased and becomes an urgent problem of every nation. Therefore, changing attitude, awareness, and consciousness together with taking action of each individual is more necessary than ever, especially in developing countries, where environmental issues do not have enough attention or concern of the states as well as residents. One of the main reasons for this situation is because propagandas and educational campaigns for citizens have not been developed and implemented effectively in terms of quality as well as quantity. This leads to a demand of primary waste management education, not academic, professional or specialized one, but basic and user-friendly so that it can be applied in daily life.

The purpose of this thesis is creating a beta ready-made lesson-plan for teachers, trainers, coaches so that they can use it in teaching and tutoring children about waste and related issues. This idea complies with the requirement of WastED Project, to which this thesis commits, that designed materials and courses are built into standard educational packages for Business-to-Business customers.

This is a product-oriented thesis, expected outcome is a booklet (exclude visual design aspect) containing basic waste-management information and class activities described in details.

1.2 Project objective and Project tasks

Project objective: Design a solid waste-management course for primary school focus on reduce, reuse and recycling - Target country: Vietnam.

The following Project Tasks (PT) will be explored and achieved in this thesis:
PT1: Literature review
PT2: Product design
PT3: Product finalize
In general, project task 1 will cover all required theories used in project task 2. Project task 2 is about creating and designing the thesis's product based on theories interpreted in project task 1. Project task 3 will take into consideration suggestions of improvement from local-teacher interviews for finalizing the product.

Table 1. Product-oriented overlay matrix

Project objective: Design a solid waste-management course for primary school focus on reduce, reuse and recycling - Target country: Vietnam **Project task:**		
Project tasks	Theory	Output (Thesis's chapter)
PT 1: Literature review	Theories for PT 2	Chapter 2
PT 2: Product design	Reverse logistics, solid waste management, primary pedagogy	Chapter 3
PT3: Product finalize	N/A	Chapter 4

1.3 Key concepts

Solid waste is defined as a substance or object, normally solid, which is discarded or required to discard from human and animal activities (Cheremisinoff & Heinemann 2003, 7).

Municipal solid waste includes all community solid waste discarded by end users, with the exception of industrial process and agricultural waste: Municipal Services, Treatment Plant, Commercial, Construction & Mining, Residential, and Institutional (Ludwig, Hellweg & Stucki 2003, 16).

Solid waste management

> "Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes. In its scope, solid waste management includes all administrative financial, legal, planning, and engineering functions involved in solutions to all problems of solid wastes." (Tchobanoglous, Theise & Vigil 1993, 7.)

Reverse logistics, defined by Rogers & Tibben-Lembke (1999)

> "Reverse logistics is the process if planning, implementing, and controlling the efficient, finished goods, and related information from the point of consumption to the point of origin, for the purpose of recapturing value or proper disposal." (McKinnon, Browne & Whiteing 2012, 254.)

Close-the-loop

> "A closed-loop supply chain includes the returns processes and the manufacturer has the intent of capturing additional value and further integrating all supply-chain activities. Therefore, closed-loop supply chains include traditional forward supply-chain activities and the additional activities of the reverse supply chain." (GuideJr. & Harrison 2003.)

1.4 Scope of the thesis

From the view of running a project, there are four stages included for this project respectively: analyze the need, design the product, implement the course, and assess and improve the project. The idea is precisely as in figure 1 below, where aspects covered in this thesis are colored in orange.

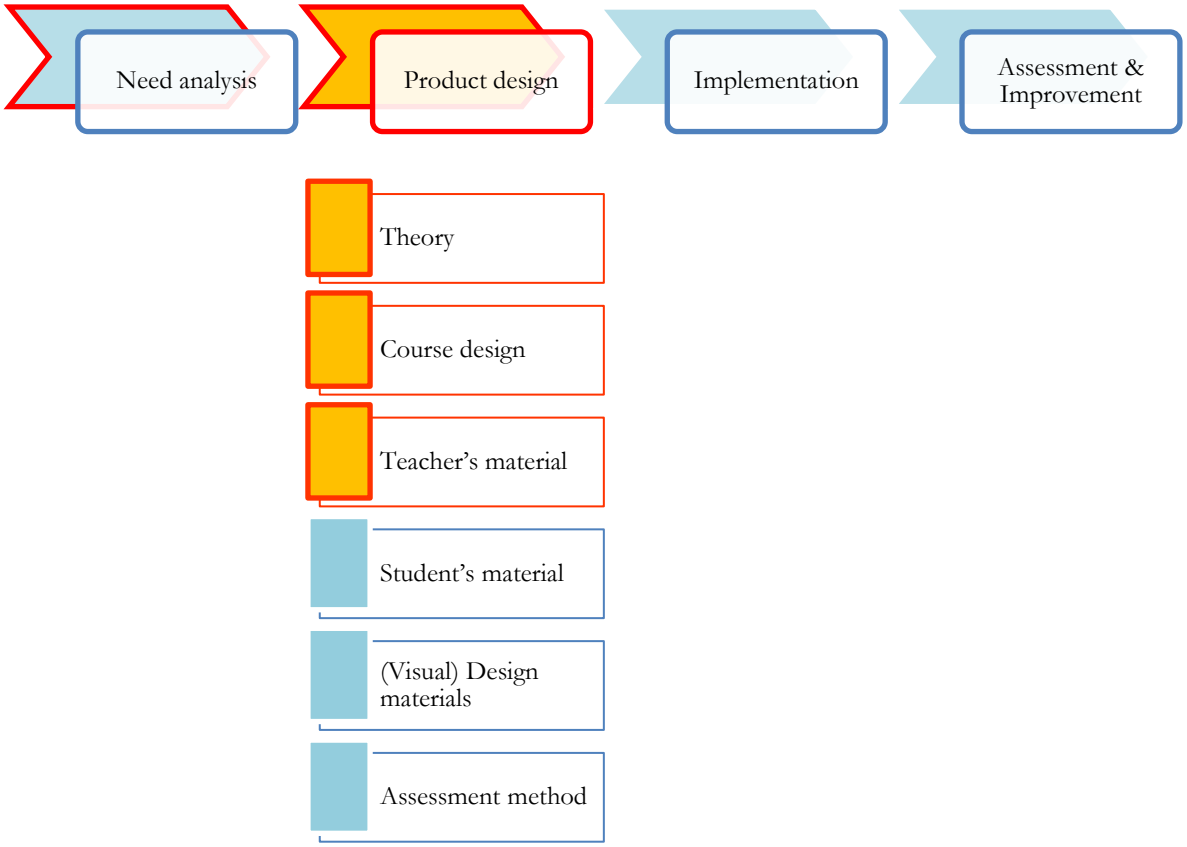

Figure 1. Thesis demarcation

In the scope of a bachelor's thesis, the first three parts of "Product design" stage will be covered, which are: theory, course design and teacher's material. Need analysis stage was conducted for the purpose of WastED project other than for this thesis so it is considered as knowledge of the author and not included in this thesis. Other aspects are mentioned as further development and suggestions when implementing the project.

This thesis' content is built with waste-management and reverse logistics as a base while teaching method is tailored from the primary pedagogy theory (figure 2).

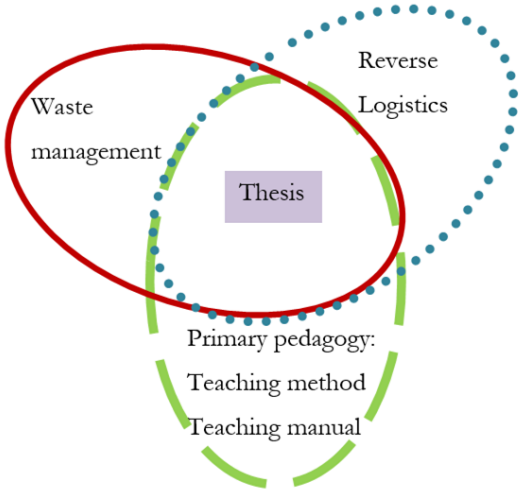

Figure 2. Thesis's theory demarcation

1.5 Aimed benefit for stakeholders

For WastED project, the output of this thesis is a semi-finished booklet which will be one of the project's materials or products. Besides, even though the thesis is tailored-made for Vietnamese market, it can also be used for other markets without major changes.

For teachers or trainers, direct users of the booklet, they will have ready-to-use lesson plan which also supports their further research. Pedagogical methods conducted for the purpose of the booklet could be applied to other courses.

For end users, pupils in primary schools, they not only have a chance to enlarge their knowledge of environmental science related to their daily activities but also are encouraged to develop new skills and social interaction through lessons and games in the course.

For primary schools, it will help improving their waste management field if the school implements the course widely. Moreover, it supports the school's brand and image since in target market, Vietnam, there has not been any primary school which has similar courses or activities.

For the author, the author wishes to have further study and future career in environmental management field. By designing the course for primary schools, the author also gains knowledge of pedagogy and experiences in building training materials.

1.6 Case company

As mentioned before, this thesis commits to WastED project – Export of Education in Waste Management. WastED is an environmental management educational project, built for the purpose of sharing knowledge and achievements in waste management field, as well as advanced pedagogy methods of Finnish education to other countries.

Started in May 2013, and estimated to end in December 2014, WastED has been funded by European Union and jointly developed by 3 institutions in Finland: Environmental School of Finland SYKLI has contributed their immense knowledge of waste management, Turku University of Applied Sciences has shared their pedagogical insights and HAAGA-HELIA University of Applied sciences has helped to package and internationalize the service product.

WastED offers educational packages, which will cover all areas of waste management from basic introduction to specialized areas based on EU framework, with updated information as well as a variety of pedagogy tools so participating trainers can proceed to implement their own training according to desired schedule.

WastED Project aims to:

> "Creating new education materials (education packages)
> Standardizing education in waste management
> Developing vocational education in the target countries
> Developing the know-how of Finnish educational institutes in export of education"
> (WastED 2013)

There are two main markets that WastED targets: Latvia and Estonia. Besides, WastED has been also expanding to other new EU countries such as Poland, Croatia,

Russa, Hungary, Czech Republic and Asian developing countries like Vietnam and Chi-China.

WastED Project status is presented in figure 3 below.

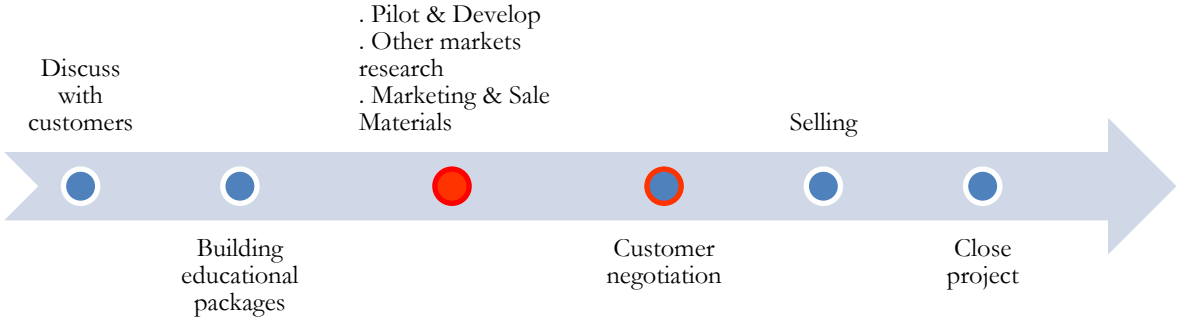

Figure 3. WastED Project timeline

In June 2013, main customers from Estonia and Latvia including representatives from partner universities and government bodies had a 4-day seminar in Turku with several workshops as well as excursions for the purpose of need analysis and information exchange. From August 2013 to December 2013, demo versions of educational packages were created. Currently, WastED team is in the stage of piloting and developing the products as well as looking to other potential markets mentioned above (Poland, Croatia, Russia, Hungary, Czech Republic, Vietnam, China). The team is also in the early stage of customer negotiation.

1.7 Thesis structure

The thesis presents four tasks of the project respectively: literature review, product design, product finalize and ends with a discussion chapter including future development for the product and the author's personal learning evaluation (figure 4).

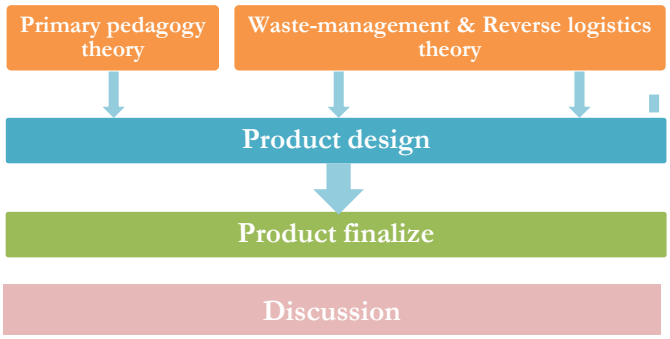

Figure 4. Description of the project

2 Primary Pedagogy (PT1)

This chapter discusses two main pedagogical methods which are considered to add value to target market's education field: Group Work and Play & Learn.

2.1 Group work

A numbers of experiments about group work were tested on pupils by Deutsch (1949): Group 1 was told that the grade would be the same to every member of the team, based on the quality of the group's product. In contrast, group 2 was told that the grade would be different based on each member's performance and contribution to the group's final result. The study found that children in group 1 whose grades depended on other team members were more cooperative, productive, nicer and less aggression than the other one. Working together to reach the same goal makes children find the way to communicate, express their ideas as well as listen to others' ideas. (Galton & Williamson 1994, 7.)

Another research conducted by an American, mentioned in Goodlad & Hirst (1989), related to cooperation effect within groups in competition that when all members of the group aim to one goal and have to compete with other groups, the links and connections in terms of friendship and tutoring among group members will be built. The outstanding members in group will help lower-level members master the task.

Wood (1988) also agreed on the group work and highly rated the social interaction in early education since it helps children to explore other points of views, open to new ideas, and encourage them to criticize their opinions and rethink with conflicting ideas raised by their group members. However, Piaget (1962) argued that this only works when the children understand the subject and in a level of ready for changing. (Galton & Williamson 1994, 7.)

Besides, Rowland (1987) also pointed out advantages and disadvantages of group-working in primary school. He consolidated the idea of having group-work activities for young children that they would learn better when they can contribute their own

views instead of only receiving one-way information flowing from teachers, yet this method could bring confusing or even wrong information in some situations when children are told by their classmates. (Galton & Williamson 1994, 18.)

Galton, Williamson (1994) and Biott (1987) had in common the idea that group works, especially for primary pupils, need to be well managed and maintained to improve the groups' quality based on children's capacity and their roles in the groups.

> "Effective group work in the classroom concerns not only the capacity of the group to complete tasks successfully but also the capacity of each pupil to be able to take on different roles within the group according to the nature of the task and the composition if the other members." (Galton & Williamson 1994, 23.)

Roles in groups:

> "Encouraging and supporting others especially weaker members
> Holding the group together in difficult moments
> Questioning others to invite participation
> Expressing doubt in a way which invites others to comment
> Trying to express a half formulated idea in a way which encourages other join
> Summarizing progress in a tentative way and slowing the pace to make the group more reflective or speeding it up to test more ideas"
> (Biott 1987, 11.)

Supporting Biott's children's-roles-in-groups study, several rules when working in groups were developed by Kingsley Mills (1992):

> "We share ideas
> We take turns to speak
> We try to agree
> We respect other people's ideas
> We listen to each other
> We involve everybody
> We don't shout or get angry
> We talk one at time"
> (Galton M. 2007, 98-99.)

In conclusion, even though group work is highly recommended for primary pedagogy, teachers' role is even more important than usual. Teachers have to understand, evalu-

ate and categorize his or her pupils to be able to balance the groups' capacity and performance (Galton & Williamson 1994, 23). Besides, teachers have to follow group-work process, guide, mentor, tutor children so that they have room for all individual contribution while receive correct information in cooperative discussion atmosphere. In addition, for the group-work preparation, children need to be taught how to cooperate so that they know what the expectations of them are. (Galton & Williamson 1994, 42-43.)

2.2 Play & Learn

Many studies have been conducted in the last few decades by Dansky (1980), Dansky & Silverman (1975), Pepler & Ross (1981), Sutton-Smith (1968), proving the correlation between play and creativity. The research tested on two groups of children: Group 1 was given materials to play while Group 2 was asked to watch adults doing things with same materials. After the activity, children went through an exam in which pupils from Group 1 excelled with high creativity compared to Group 2.

Similar philosophy to Group-work, when children are put to play, which requires interaction among individuals, it will improve social development as well as problem solving skills of children. In playing, children learn to share materials and space, negotiate for any arising conflict (if instead of solving the conflict for them, teachers encourage them to "work it out"). Furthermore, a research done by Rubin (1985) showed that children who frequently join the social play are popular and have higher scores on interpersonal and social-problem solving skills. (Stinson 1990, 45.)

3 Solid Waste Management (PT 1)

This chapter clarifies waste-management theory for the purpose of building the course and booklet content. It includes sub-chapters of waste-management overview, implication, classification, recycling and close-the-loop.

3.1 An overview

This overview sub-chapter generally explores solid waste by giving definition of key concepts, introducing its historical development and waste hierarchy.

3.1.1 Definition & demarcation

Solid Waste is defined as a substance or object, normally solid, which is discarded or required to discard from human and animal activities (Cheremisinoff & Heinemann 2003, 7). In different literatures, solid waste is classified into various categories according to the studying or professional researching purposes. Tchobangolous, Theisen and Vigil (1993, 40) developed a source-classification for solid waste related to land use and zoning as followed:

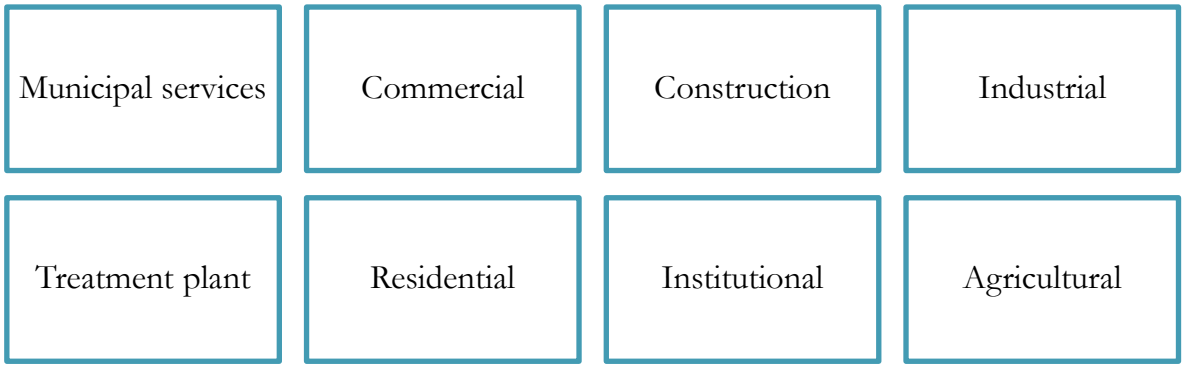

Figure 5. Eight source groups of solid waste (Tchobangolous, Theisen and Vigil 1993, 40.)

The following table 2 presents sources of solid waste, activities of location where waste were generated and common type of solid waste in the community.

Table 2. Sources of solid wastes within a community (Tchobanoglous, Theise & Vigil 1993, 41)

Source of waste	Typical facilities, activities or locations where wastes are generated	Types of solid wastes
Residential	Single family and multifamily detached dwellings, low-, medium-, and high-rise apartments, etc.	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum, other metals, ashes, street leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), household hazardous wastes
Commercial	Stores, restaurants, markets, office building, hotels, motels, print shops, service stations, auto repair shops, etc.	Paper, cardboard, plastics, wood, food waste, glass, metals, special wastes (see above), hazardous wastes, etc.
Institutional	Schools, hospitals, prisons, governmental centers	As above in commercial
Construction and demolition	New construction sites, road repair/ renovation sites, razing of building, broken pavement	Wood, steel,, concrete, dirt, etc.
Municipal service (excluding treatment facilities)	Street cleaning, landscaping, catch basin cleaning, parks and beaches, other recreational areas	Special wastes, rubbish, street sweepings, landscape and tree trimmings, catch basin debris, general wastes from parks, branches and recreational

		areas
Treatment plant sites; municipal incinerators	Water, wastewater, and industrial treatment process	Treatment plant wastes, principally composed of residual sludge
Municipal solid waste	All of the above	All of the above
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.	Industrial process wastes, scrap materials, etc. Non-industrial waste including food waste, rubbish, ashes, demolition and construction wastes, special wastes, hazardous wastes.
Agricultural	Field and cow crops, orchards, vineyards, dairies feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes

Municipal Solid Waste

Environmental Department of European Union has different waste classifications for municipal solid waste based on the waste's characteristics and industry fields compared with Tchobangolous, Theisen and Vigil's one. There are more than 40 types of waste belongs to municipal solid waste listed in the European Commission (2000). However, in order to accomplish the purpose of the thesis, Tchobangolous, Theisen and Vigil's method of categorizing, which is based on the sources of solid waste, was chosen.

Municipal solid waste includes all community solid waste discarded by end users, with the exception of industrial process and agricultural waste: Municipal Services, Treatment Plant, Commercial, Construction & Mining, Residential, and Institutional (Ludwig, Hellweg & Stucki 2003, 16). The study will focus on two part of the municipal solid waste: Residential waste - aiming to household waste, and Institutional waste – aiming to school waste. Hence, the term Municipal Solid Waste in this report will stand for Residential (household) and Institutional (school) Solid Waste.

Residential Solid Wastes

Residential solid waste is defined as waste generated by daily activities of single as well as multi-families, consists of organic, non-organic, special and hazardous waste: food waste, paper, cardboard, plastics, textiles, leather, garden waste, wood, glass, tin cans, aluminum, other metals, ashes, tree leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), household hazardous wastes. (Tchobanoglous, Theise & Vigil 1993, 41.)

Institutional Solid Waste

Institutional solid waste is defined as waste generated from activities of government centers, schools, prisons, and hospitals. As mentioned before, main focus of the study in institutional solid waste is school waste. Hence, the term "institutional solid waste" will stand for waste produced by schools: paper, cardboard, plastics, wood, food waste, glass, metals, hazardous wastes, etc… (Tchobanoglous, Theise & Vigil 1993, 41.)

Municipal Solid waste management

> "Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes. In its scope, solid waste management includes all administrative financial, legal, planning, and engineering functions involved in solutions to all problems of solid wastes." (Tchobanoglous, Theise & Vigil 1993, 7)

3.1.2 Historical development

According to Tchobanoglous, Theise & Vigil (1993, 7), The Disposal of Municipal Refuse written in 1906 by H. de B. Parsons can be seen as the very first book discussing and giving basic principles and methods for dealing with the solid waste subject. In comparison with waste management system of 1900s, while collecting method is almost the same, treating solution is a significantly changing part in the chain. In collection stage, even though modern trucks have replaced the old horse-drawn carts, human labor is still an intensive factor. However, back to the old days of 20th century, com-

mon methods for solid waste treatment in respective order are: "dumping on land, dumping in water, plowing into the soil, feeding to hogs, reduction and incineration". Nowadays, along with the development of human society, a hierarchy of waste has been built not only because of the increase in complexity of products but also due to the shortage of natural resources as well as the limited self-recovery of the earth.

3.1.3 Waste Hierarchy and 3Rs

Waste hierarchy presents different waste treatment methods, placed in an inverted triangle, in the order of the preference fewer impacts on the environment and human society.

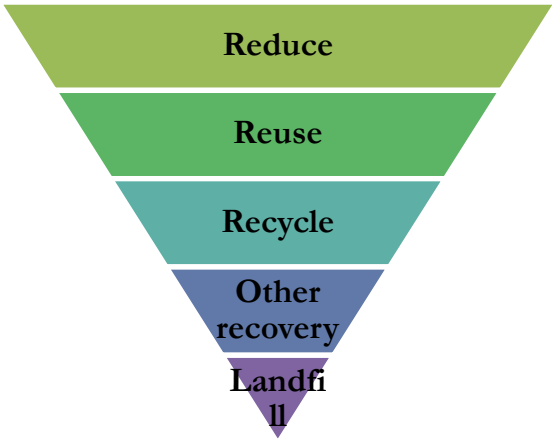

Figure 6. Waste Hierarchy (Tchobanoglous, Theise & Vigil 1993, 15)

Reduce – Prevention – Source Reduction

Reducing waste at source both in quantity and quality (like toxic chemicals, dangerous gadgets or apparatus…) is the significant factor to help cutting down the pressure on waste management for all stages (handling, collecting, storing, treating and disposing) and lowering the costs as well as environmental impacts…(Tchobanoglous, Theise & Vigil 1993, 15-16). Besides, reducing waste at source is the simplest way which can be applied and done by any person (housewives, children, workers, managers..) at any time (begin, during and at the end of manufacturing process including packaging and delivering) in any place (households, schools, companies…)(Cheremisinoff & Heinemann 2003, 8-11).

Reuse means the products, after the first use, may lose total or a part of its value. However, without or with little changes, their value could be recreated. Beverage glass bottle is an outstanding example for this. (Cheremisinoff & Heinemann 2003, 11-13.) When all the liquid inside the glass bottle is consumed, those bottles will be returned to producers, processed for another round of reusing as liquid containers. Rechargeable battery is also counted as a reusable product. (Tchobanoglous, Theise & Vigil 1993, 17-20.)

Recycle takes place when product is at the ending stage of its life cycle. Those products, after being separated, will be remanufactured to become new products, or raw materials, which help to solve the problem of natural resources limitation. (Tchobanoglous, Theise & Vigil 1993, 20-25.) It can be very simple like recycling packing boxes or toilet-paper roll cores to make some house-decoration or toys for kids which we can do at home. Or it can be as complex as recycling mobile phones or cars like Nokia, Nissan ext. (Cheremisinoff & Heinemann 2003, 14-16.)

Other recoveries include all type sof waste transformation: physically, chemically or biologically. For instant: organic waste will be composted to become fertilizer or mulch which is very suitable for cultivation, while mixed waste is burned to produce heat or electricity. Ash, which is left after waste is burned completely, will be used for covering the landfill with other components. (Tchobanoglous, Theise & Vigil 1993, 15-25.)

Disposal in landfill is the last stage in solid waste hierarchy, which, according to theory, should be applied only when the other waste treatment methods cannot be used. However, due to the overload of produced waste or limited of infrastructure, equipment or technology, landfill has been the most common way used so far. Of course waste-disposal rate is different in different countries, yet, still, it accounts for more than 50% total waste generated worldwide. (Tchobanoglous, Theise & Vigil 1993, 25.)

3.2 Effect and Consequence of Solid Municipal Waste

In the early time, the earth itself had the power to absorb, dilute, transform, reduce and balance the impact of animals' and humans' disposal. However, along with the devel-

opment of human society, waste has been increased dramatically, from industrial factories, agricultural mass-production field, heath services, mining and construction, daily-life activities and so on, which exceeds the self-recovery ability of the planet. Poor-storage food wastes or organic wastes are the ideal places for rats, flies and other disease vectors. Untreated nylon bags, battery or house-cleaning chemicals ext. can poison the water sources as well as soils. (The National Environmental Report 2011, 99.)

The purpose of this chapter is to bring general information how improper municipal solid waste management, from daily-life activities – residential and institutional wastes, causes and affects backward human and the environment (figure 7).

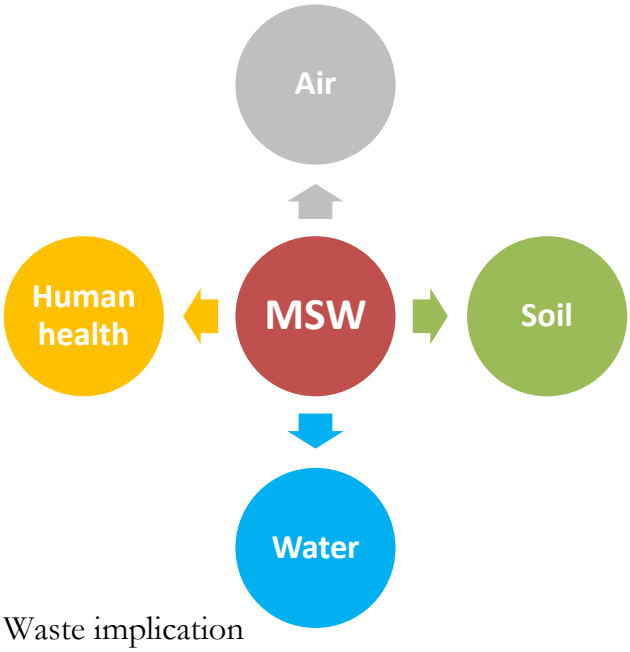

Figure 7. Waste implication

3.2.1 Air Pollution

Solid waste, especially municipal solid waste contents mostly organic substances. Under the effect of temperature, humidity and microorganisms, organic municipal solid wastes such as food waste, garden waste, paper, textiles, resins, bitumen and so on are decomposed, produce gases: mostly CH_4 – 63.8%, CO_2 and some other gases (Popov & Power 1999, 11). The process of gases producing starts after 10-50days the waste stored in landfill and can continue for over 100 years (Popov & Power 1999, 12). According to a study, methane from landfill account for 40-60% of landfill gases (Ludwig

& Stucki 2003, 24) and 38% of total anthropogenic sources (Popov & Power 1999, 13) which are the main gases cause greenhouse effect.

Organic substances are decomposed during the transportation and storage process will lead to the occurrence of odor, pollutes the environment: Ammonia smells of urine, excrement has foul smell, Hydro Sulfur has rotten egg smell, organic Sulfur has rotting cabbage smell, Mercaptan & Cl_2 smell stink, Amin has rotten fish smell, Phenols has smell of snail ext. (The National Environmental Report 2011, 101.)

Besides landfill activities, incineration treatment method also contributes to the air pollution. Burning garbage will produce smoke, dust and unpleasant odor. Municipal solid wastes may content compounds of Chlorine, Flo, Sulfur and Nitro which can transfer to toxic emission or corrosive effect. Moreover, if the temperature of incineration plant is not high enough or gas-collection and management system does not meet the standard, solid waste will not be completely destroyed which produce carbon monoxide, nitrogen oxides, dioxins and furans, evaporative and very toxic substances for human health. Even though dust pollution is usually the main reason of public grievance because it can easily be seen, the more dangerous element are the compounds such as heavy metals, dioxins and furans, on the surface of dust particles – invisible to human eye - released into air. (The National Environmental Report 2011, 101-103.)

The potential impacts of the gas generated from landfill are as follow.

- Potential explosion caused by the accumulation of gases in confined areas.
- Crops and vegetation damage due to the effect of the amount of oxygen in land
- Some gases (such as NH3, CO, and volatile organic acids), although generated in small amount, they are very toxic to plants and potentially limit the growth of plants
- Irritation due to the stench from the landfill with NH3, H2S, CH3.
- Noise from the presses operated gas collection system, trucks and garbage treatment plants.
- Greenhouse by landfill-generated gases: CH4 and CO2
  (The National Environmental Report 2011, 103.)

3.2.2 Water pollution

Uncollected solid waste, directly dumped to canals, river, lake, ponds causes water-environmental pollution, water-circulation congestion, reduces the tangential surface between water and air, reduces dissolved oxygen (DO) in water. Solid organic waste decomposition in water releases foul odor, changes water color into black and causes aquatic organisms impairment. (Tchobanoglous, Theise & Vigil 1993, 5.)

Typically, waste landfills have proper techniques of piping, collecting canals, cisterns and treating system for waste water before discharge into the environment. However, with landfills are not properly constructed and hygiene equipment is overloaded, land-fill-water leakage is discharged directly into lakes causing serious water pollution. Besides, the occurrence of spontaneous landfill is also a significant source of water pollution. (The National Environmental Report 2011, 104-106.)

3.2.3 Soil pollution

The solid waste can be accumulated under land in the long period causes potential danger to the environment. Construction waste such as brick, tile, glass, plastic pipes, cables, concrete ext. is difficultly decomposed in soil. Metal waste, especially heavy metals such as lead, zinc, copper, nickel, cadmium ext. often occurs in mining district or industrial areas. These metals accumulate in soil and penetrate the body through food and water, significantly affects human health. Some types of waste can create pollution in large extent of land are detergent, fertilizers, plant protection chemicals, dyes, paints, battery manufacturing, tanning, industrial manufacturing chemical ext. (The National Environmental Report 2011, 107-108.)

The effect of plastic bags

Plastic bags are difficultly decomposed substances, when released to the environment, they take decades to a few centuries to be fully biodegradable in nature. Incomplete decomposition of plastic bags will leave debris in the soil; no conditions for microorganism making soil become infertile. The existence of plastic bag in environment will

cause serious impact to the land since it prevents oxygen passing through the land, causing soil erosion, making the soil not able to hold water and nutrients. (The National Environmental Report 2011, 109.)

3.2.4 Human health

Poor management and disposal of solid waste is not only the cause of environmental pollution but also a great influence to human health, especially for people living near industrial or burial areas. (The National Environmental Report 2011, 110.)

People living near unhygienic landfills have incidence of skin diseases, bronchitis, and osteoarthritis pain much higher than elsewhere. A study in Lang Son, Vietnam (2009) showed the percentage of people suffering from the illness and diarrheal diseases, dermatology, respiratory ext. in areas affected by landfills are significantly higher than people in non-landfill-affected areas. (The National Environmental Report 2011, 110.)

There is none adequate data to assess the impact of the landfill on the health of the workers picking up garbage. However, these people often suffer high levels of dust, pathogens, toxic substances, insect steam injection and various types of toxic gases during work. Therefore, the common problem in this subject is the disease of influenza, dysentery, worms, tuberculosis, stomach, diarrhea, and other intestinal problems. (The National Environmental Report 2011, 111.)

Landfill is another potential risk to the community working on it. Sharp objects, broken glass, old needles ext. could be dangerous threat to human health (infectious diseases such as AIDS infection) when they are stepped on or make scratched limbs. Another issue to be considered is, by a large proportion of the workers picking up trash, women and children have become target groups vulnerable. (The National Environmental Report 2011, 111.)

Two components of solid waste classified as extremely dangerous are heavy metals and persistent organic compounds. These compounds have the ability to bio accumulate in agricultural products and foodstuffs as well as in animal tissue, water and sustainable

survival in the environment, cause a series of dangerous diseases to humans such as infertility, teratogenic defects in newborns; impact on the immune system causing heart disease, paralysis of the nervous system, reduce the ability of blood metabolism, cancer and malformation possible sequelae to 3rd generation. (The National Environmental Report 2011, 112.)

Agricultural waste, animal waste in particular is one of pressing problems of farmers. There are farming areas in which livestock wastes pollute air and water, soil and adverse impacts on human health. A survey done with 113 households raising from 20 or more pigs in Thai Nguyen Province, Vietnam (2008). It found that nearly 50% of households having houses 5-10m or water wells 5m - near pigsty, had the percentage prevalence of Ascaris, Trichuris, and Hookworm eggs almost two times higher than the average rate of intestinal parasitic infection of non-farmers. In addition, there is positive correlation between the prevalence of intestinal parasites and parasite prevalence in farm-land. (The National Environmental Report 2011, 113.)

3.3 Municipal Solid Waste Classification

This chapter will discuss what could be the ideal method of sorting waste (at source) based on the current situation of waste processing and handling system available. Table 3 below show how common types of municipal solid waste are sorted to different waste classification by Tchobanoglous, Theise & Vigil.

Table 3. Solid Waste Classification (Tchobanoglous, Theise & Vigil 1993, 42.)

Common municipal solid waste	Waste classification
Food waste, paper, cardboard, plastics, textiles, and rubber, leather, wood, and yard wastes	Organic fraction includes
Glass, crockery, tin cans, aluminum, ferrous metals, and dirt.	Non-organic or inorganic fraction includes
bulky items, consumer electronics, white goods, ward wastes, batteries (can be sorted in hazardous waste as well), oil, and tires	Special waste includes
Cleaners – cleaning, personal, automotive, paint, garden product (more from the attachment 2)	Hazardous waste

Hazardous waste has been defined as wastes or combination of wastes that pose a substantial presence or potential hazard to human or other living organisms because such wastes are non-degradable or persistent in nature. They can be biologically magnified, they can be lethal, or they may otherwise cause or tend to cause detrimental cumulative effects. Properties of waste material that have used to assess whether a waste is hazardous are related to the questions of safety and health. (Tchobanoglous, Theise & Vigil 1993, 100.)

Even though Tchobanoglous, Theise & Vigil (1993, 42) had clearly classified waste into concrete packages, it is considered not compatible with current recycling system since it did not clarify enough in detailed. On the other hand, waste sorting guides of Turku city, Finland were found to be suitable not only for further waste processing but also user-friendly for citizens (table 4).

Table 4. Turku Waste Classification (Turku waste guide 2013)

Organic waste	Food scraps Fruit and vegetable skins and peels Coffee grounds and filter papers Tea leaves, tea bags Paper towers and napkins Potting soil and plant parts	Used for producing biogas and fertilizers
Metal	Rinsed metal tins and cans Aluminum trays and foil Metal lids and bottle caps Used pots and pans Empty, depressurized aerosol cans Empty paint tins Small mechanical components	Used for producing new metal objects
Glass	(packing glass only) Glass bottles and jars NO glass or porcelain tableware, ceramics. Decorations, mirrors, windows or windscreens	Used for producing glass wool and new packaging
Paper	Newspapers and magazines Advertisements Envelopes Photocopy and notepad paper Phone books Broken books (without covers)	Used for producing newsprint
Cardboard	Milk and juice cartons Ice cream cartons Cereal, biscuit and sweet boxes Disposal plates and wrappers Egg cartons and paper roll cores Sugar and flour bags Cardboard boxes NOTE: Rinse clean of any food scraps and	Used for producing paper roll cores

	drains. Compress and stack	
Burnable waste/ Energy waste	(daily house waste, such as) Plastic bags and wrappers Dirty board, cardboard and paper Diapers and other hygiene products Cleaning items such as vacuum cleaner bags Worn-out clothes and shoes CDs, videos and cassette tapes Food and plant waste	Creating heat or electricity
Hazardous waste	Paints, varnishes, glues, solvents Oils, oily waste, automotive fluids Chemicals with hazard symbol Batteries (can also be returned to shops) Medicines, thermometers containing mercury (can also be returned to pharmacies) Disposable gas bottles (non-disposable gas bottles to be returned to the seller) Fireworks, emergency rockets and other explosives must be returned to the sellers	Disposal in hazardous waste plants
Landfill waste	Only non-recyclable waste not suitable for burning Glass and porcelain dishes, ceramics Mirrors, windows, glass shelves Incandescent light bulbs (not fluorescent or energy-saving bulbs) PVC plastics, such as folders, plastics sleeves, inflatable toys and mattresses, waster proof clothing Potting soil, ashes, cat litter	Deposal in landfill
Electrical and Electronic scrap	Refrigerators, cookers, washers TV, stereos, computer equipment Small electronic devices such as phones, shav-	Sent to manufactures for use of parts

	ers, electric mixers, etc… Lamps, fluorescent bulbs and energy-saving bulbs	
Large items	(take to waste treatment center) Large metal items Mattresses Furniture toilets and sinks	Furnishing materials are recycled or used for energy production
Garden waste	Tree branches Leaves and rakings Clean grit (Garden waste is too heavy for normal waste containers. Sand and damp garden waste are also harmful for incinerators)	Used in landscaping and for energy production
Construction waste	(taken to waste treatment center) Clean, treated or impregnated wood Waste suitable for burning Plastics Plate glass Landfill waste Bricks and concrete Soil and mineral waste Bitumen Asbestos (packed and approximately labeled)	Mostly recycled and used for energy production

3.4 Waste-Recycle & Close-the-Loop

Waste-management and reverse logistics have an overlapping area which is called waste-recycle in waste management and close-the-loop in reverse logistics. Even though there might be differences in definition of each term according to different literatures, waste-recycle and close-the-loop's core is about the process of recreating the value of items after their initial using purpose. For example product containers are returned to producers or third parties, where they are remanufactured to become raw materials, which can be used to produce the same original products or other products.

Since close-the-loop and waste-recycle have been defined respectively in sub-chapter 1.3 and 3.1.1, this sub-chapter will focus on what will happen with the returned items made from metal, plastic, glass, paper and cardboard.

3.4.1 Metal (Aluminum and Steel)

Municipal recycling metals commonly are aluminum and steel, which can be sorted based on types of original products or tested by magnets. Aluminum often exists in: wrapper, aluminum plates, can, garden, furniture, aluminum containers, foils, construction material ext.; while steel is usually found in: motors, tools, food cans, framing material, nails, construction beams and girders ext. New aluminum and steel product, which are made from recycled items, will save 95% energy compared to processing new ones. (Tchobanoglous, Theise & Vigil 1993, 60) See those as raw material, we can continue producing cans, furniture, tools... and there is no time limitation for aluminum recycling (Sukalich 2012).

Figure 8 clearly presents how aluminum is produced and recycle.

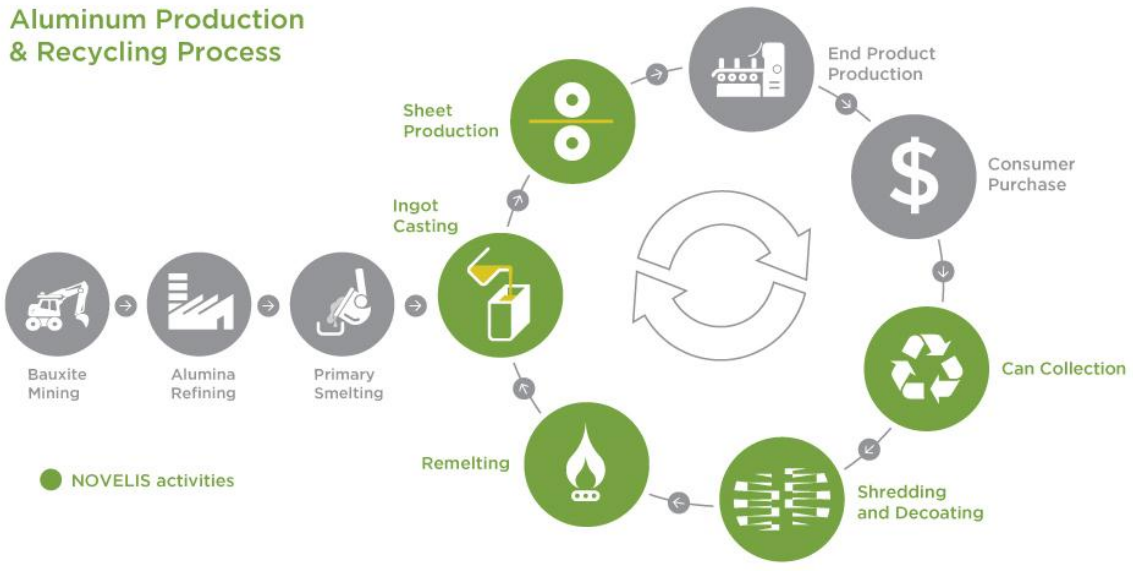

Figure 8. Aluminum Production and Recycling Process (Novelis)

3.4.2 Glass

There are also variety of glass types and ways of classifying glass. Follow the Finnish municipal sorting waste guide, packing glass should be separated into colored and clear type (Tchobanoglous, Theise & Vigil 1993, 258). Glass containers if not reusable because of exceeding reusing cycles, will be crushed before melted & molded into new products (such as bottles and jars or other purposes like decoration) due to economic reasons: reducing storing space and saving shipping cost (figure 9) (Recycling guide).

Similar to metal, especially aluminum, "glass does not degrade through the recycling process, so it can be recycled again and again" (Recycling guide).

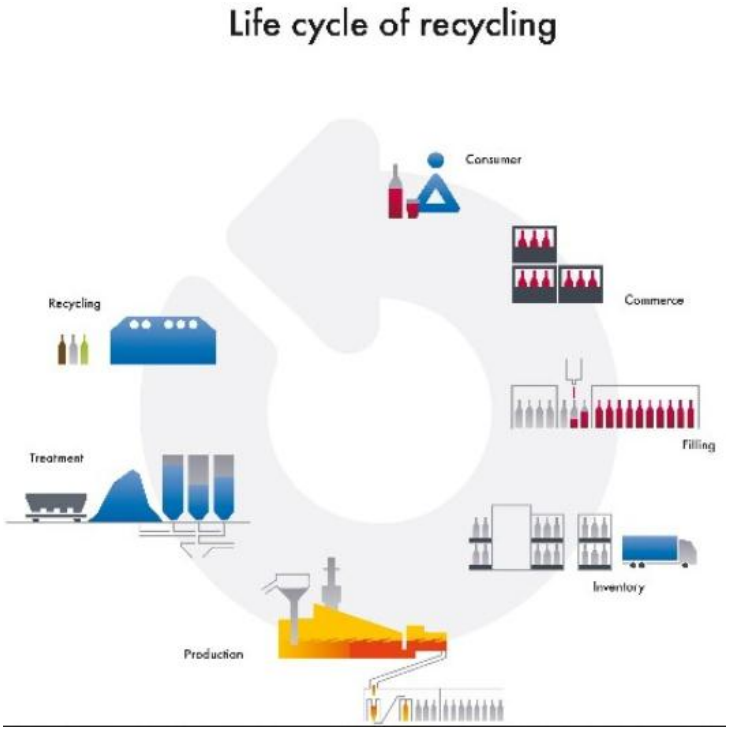

Figure 9. Life cycle of Glass (Vetropack)

3.4.3 Plastic bottles

Recycled plastic which has PET sign, usually found from plastic containers of soft drink, beverage. Returned plastic bottles will go through the process of crashing into small pieces, melting and shredded which will be used as input material for new products such as clothes, gloves, jacket, bottles, containers, vehicles' parts, carpets, fiberfill and many more. Another plastic type is HDPE, "used in milk, water, detergent, and

motor oil containers, can be remanufactured into trash cans, bathroom stalls, plastic lumber, toys, trash bags, and hair combs". Recycling 5 plastic soda bottles help to produce one XL T-shirt. (EPA 2005, 104.)

Figure 10 below only shows the first part of recycling process when the checking takes place for separating items into reusable packages and recyclable packages.

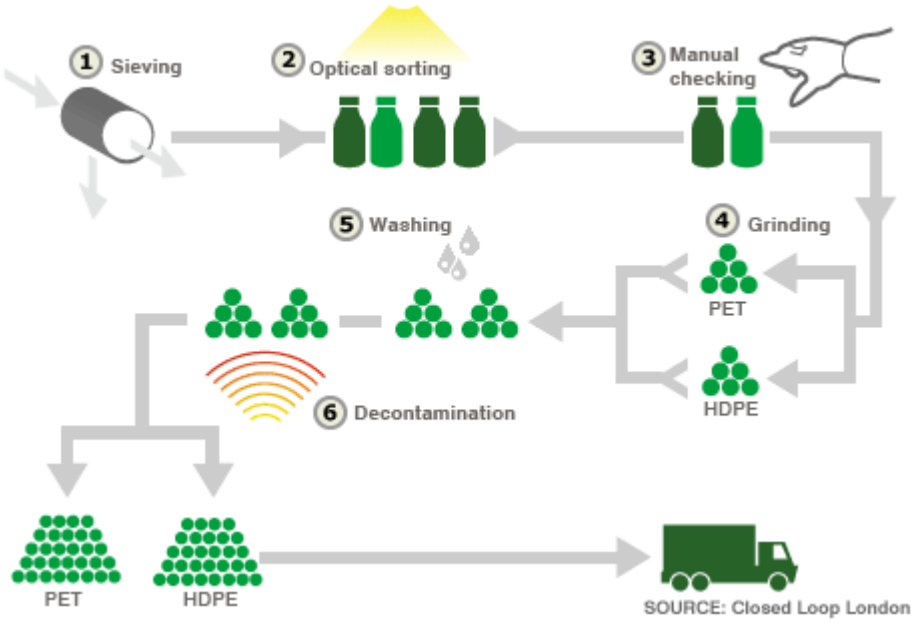

Figure 10. Life cycle of plastic bottles (Jeavans 2008)

3.4.4 Paper & Cardboard

Since paper can cardboard has been the second largest components of municipals solid waste (Tchobanoglous, Theise & Vigil 1993, 723) recycling papers plays a significant role helps reduce landfill and forest loads as well as energy consumption in processing new paper and mill. According to the EPA, every ton of paper recycled saves more than 3.3 cubic yards of landfill space, 17 trees, 7 000 gallons of water and 463 gallons of oil and enough energy to heat an average home for 6 months. However, since the quality of fibers in paper is shortened and weakened each time it goes through the recycled processed, average recycled times for recycling paper are five to seven. For recycling, papers will be deinked and turned back into pulp in order to produce another product(s) which required lower fiber quality compared to the original ones. When

fiber becomes too short, producers have to add virgin fiber to hold it together. (Claiborne 2010.)

An example of paper products is showed in figure 11.

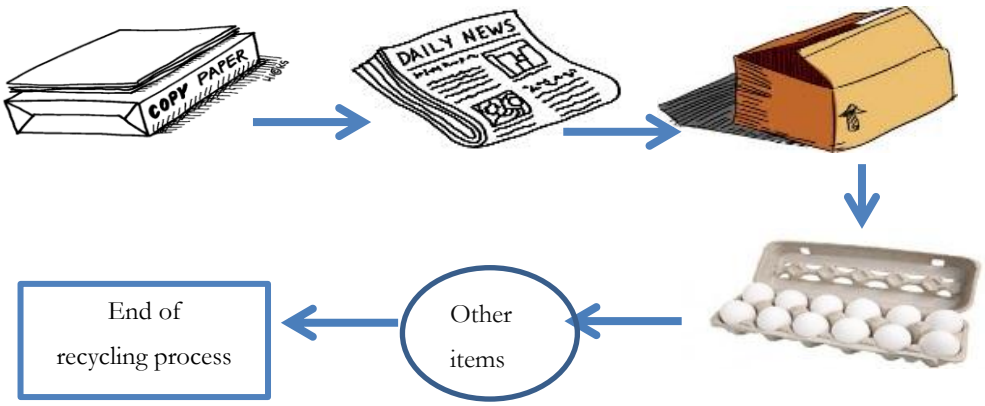

Figure 11. Paper products in paper-recycling process

Figure 12 presents how paper is manufactured from raw material to final paper product and when the recycling takes place.

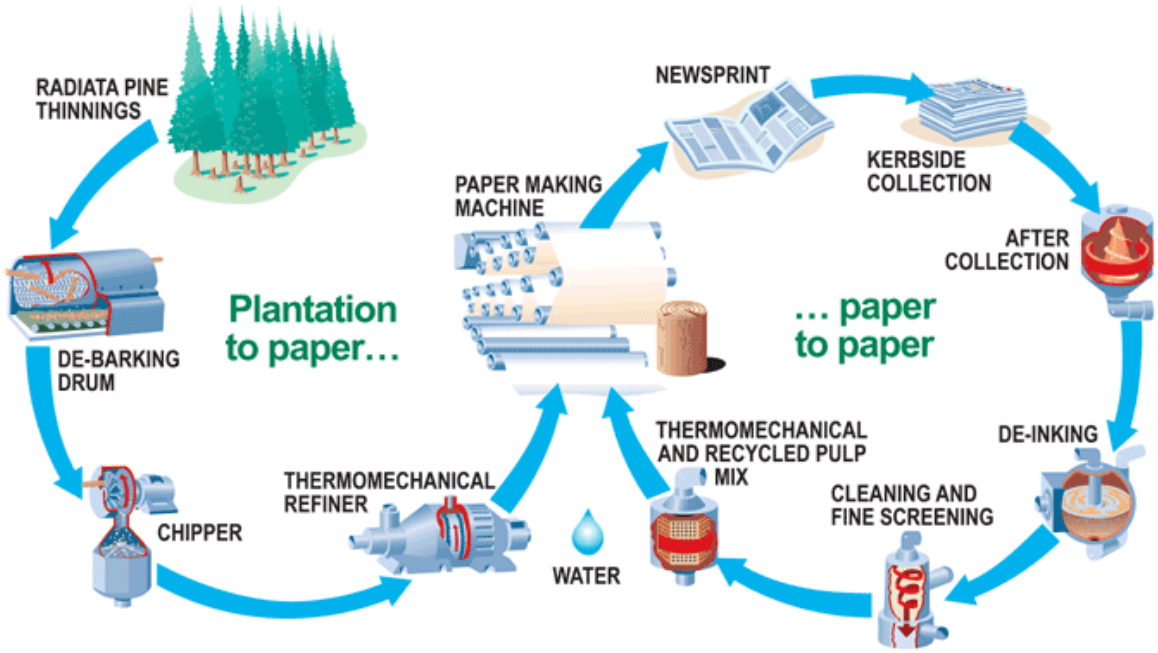

Figure 12. Paper life cycle (Claiborne 2010)

4 Product design (PT2)

This chapter explains how the booklet was created and designed based on the purpose of the course and timeline of WastED project.

Purpose of the course is raising children's awareness of their living environment status, building the sorting-waste-at-sort habit and increasing 3Rs reduce-reuse-recycle rate in schools as well as in home.

Limited hours for the course is approximately 10 - 16 hours of contact lessons in total.

Notice that the outcome of product design can be referred to Attachment 1. However, Attachment 1 is the final booklet of this project.

4.1 Booklet structure

Overall, the booklet is divided into two main themes.

- Waste-introduction theme covers general information of waste's definition, implication and classification, serving the purpose of raising children's awareness and sorting-waste
- Waste-management theme mainly includes waste hierarchy, reduce-reuse-recycle, especially recycle-waste and close-the-loop, will communicate the purpose of increasing 3Rs through class activities during the lectures.

Since the booklet works as an independent guidebook, it should have all needed information for users' self-study, related to the course's lessons as well as detail instructions on how to implement and run the class's activities in the most effective way. Hence, each theme's content will be split up into two parts.

- Teacher's paper is for all theories and philosophies of background study
- Class activities describe and clarify the activities' objectives, description, needed materials, estimated time, required and improved skills, and steps of taking actions.

4.2 Booklet content

This sub-chapter will explain how content of the booklet is created along with the aimed goals of the course (figure 13). It includes 2 smaller parts: content transmission and method transmission.

Even though the product is aimed for teachers or trainers, considering the possibility that there could be some users who do not have background knowledge on waste management, definitions of all key concepts are included and well explained in each theme. All unnecessary information which is not included in the performed lessons and activities is discarded from the booklet to keep the content concise.

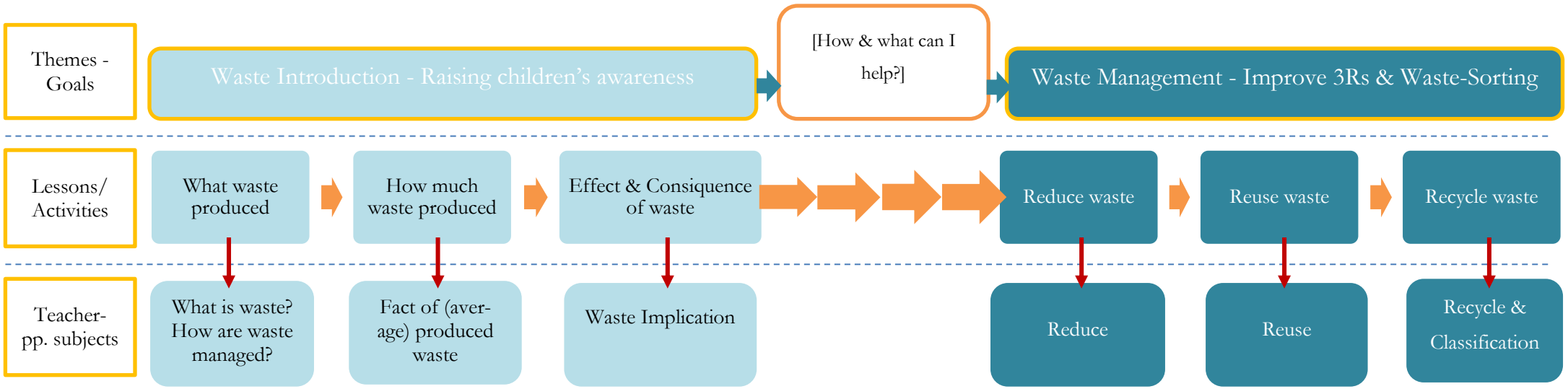

Figure 13. Booklet Content Building Process

4.2.1 Content transmission

This part clarifies class's activity-ideas and subjects deduced from those will be chosen for teacher's papers (figure 13).

Scoffham (1999) pointed out that "much of the information which children obtain about their environment comes from first-hand experience", hence it is important for teachers, trainers to have the right methods and take the right actions in order to arouse children's consciousness and responsibility so that their actions towards environment comes from their willingness. The course is built in order to achieve this purpose. (David 1999, 125.)

For waste-introduction theme

There are three activities under the waste-introduction theme.

Firstly, children are encouraged to think about **what kinds of waste they generate**

Secondly, continue from the result of first stage, children start to explore **how much waste they produce.**

And thirdly, they are inspired to find out **what effects and consequences** come from that.

Through these activities, children get familiar with concepts of waste and aware of how their daily-life actions could affect other people and environment around them. Waste-introduction theme is successfully implemented when after those lessons, children start to think "What and how can I help to improve/ to change the situation?"

Following are **activities** implemented in the course.

- Activity 1 (A1): **Let's be a spy** – Activity's objective: Encourage children to think about the waste they produce
- Activity 2 (A2): **How much waste do you produce?** – Activity's objective: Raise awareness of student about the amount of waste they generate
- Activity 3 (A3): **How do our wastes affect people and the environment?** - Activity's objective: Raise awareness of student about effects and impacts of waste on environment and human

Corresponding to waste-introduction activities, topics chosen for **teacher's paper** serve the purpose of running those lessons.

- **What is solid waste?** – This subject covers definition and eight source types of solid waste, municipal solid waste (Tchobanoglous, Theise & Vigil 1993 model)
- **How we manage municipal solid waste?** – This subject covers explanations for 6 stages of municipal solid waste management in Vietnam (it may be different for other countries).
- **Effect and consequence of municipal solid waste** – This subject covers four main areas affected my municipal solid waste: air, waste, soil, human's health.

For waste-management theme

After three activities of waste-introduction theme, children have known and are aware of waste produced from their daily activities, it is very essential that teachers continue stimulating children's enquiry into finding solutions to help improving the situation. At this point, trainers play a role of leading and mentoring them to create ideas of **Reduce**, **Reuse** and explore **Recycle** waste. In addition, teachers will guide children **sorting waste at source** which will help to increase the recycling rate and decrease amount of waste to landfill.

However, although reducing is defined differently to reusing waste, there's an overlapping area of these two. Hence, explained definition of reducing and reusing waste can be combined as source reduction to avoid confusion for children, even though two separate activities are kept.

Following are **activities** implemented in the course.

- Activity 4 (A4): **Earth saver - Reduce** - Activity's objective: Encourage children to create ideas and take actions of reducing waste at source
- Activity 5 (A5): **Earth saver - Reuse** - Activity's objective: Encourage children to create ideas and take actions of reuse discarded stuff around them

- Activity 6 (A6): **Earth saver - Recycle** - Activity's objective: Help pupils recognizing the differences of materials and learn to sort them as well as understanding the recycling process of products
- Activity 7 (A7): **Sort your waste** - Activity's objective: Help pupils learning to sort waste at source and starting applying in daily life

Corresponding to waste-management activities, topics chosen for **teacher's paper** serve the purpose of running those lessons.

- **What is waste hierarchy?** – This subject covers waste hierarchy definition & chart.
- **What is source reduction?** – This subject covers definitions and examples of reducing and reusing waste.
- **What are benefits of source reduction?** – This subject covers benefits of source reduction action.
- **What are challenges of source reduction?** – This subject covers challenges when taking source reduction actions in practice.
- **What is waste-recycling?** – This subject covers definition and explanation of how recycling works.
- **What can be recycled?** – This subject covers recycle-process of four main recycled materials: aluminum, plastics, glass, paper and cardboard.
- **How is waste sorted?** – This subject covers full waste classification (Turku Waste Guide 2013) with highlight suitable & specific waste groups applied for Vietnamese market.

4.2.2 Method transmission

On one hand, Rowland's point (1987), which has been discussed in chapter 2 of this thesis, said that children will learn better when they can contribute their own views instead of only receiving one-way information flowing from teachers. On another hand, Goodlad & Hirst (1989) and Wood (1988) proved that there is a number of advantages of group work in early education such as improving negotiating, discussing, and ratiocinating skills which are used to protect their own opinions; critical thinking

skill by comparing, analyzing and assessing each other ideas; and more importantly that team members learn to support each other to reach better results in order to compete with other teams in class. (Galton & Williamson 1994, 18.) Hence, the course exploits these benefits by applying activity of self-discovering, which means children will be given a topic then do their own research as homework, as well as group-work in most of the lessons: A1, A2, A4, A5, A6.

Stinson (1990) gathered and generated many studies which showed that playing has an important role in children's development and learning. Children, who are encouraged to play in an organized manner with the purpose of learning, developed their creativity, problem solving skill and interpersonal skill better than the ones who only listen to teachers' lectures. Hence, play-to-learn philosophy is installed flexibly with different core-aiming skill in each lesson (table5). In another word, each lesson is designed in a form of a game, interacting between teacher and children, children and children rather than a traditional lecture.

Table 5. Main developed skill in class's activities

Main developed skill	Lesson (Activity)
Observing	Spy game (A1)
Measuring	Calculate game (A2)
Communicating	Reporting game (A3)
Problem solving	Brainstorming game (A4)
Creating	Handmade game (A5)
Classifying	Differentiating game (A6)

Other skills are also noticed to be improved and developed along with the lessons: brainstorming, presentation, recording, generating information, researching, calculating and so on.

4.3 Booklet organization

This chapter explains the idea of how information is presented and organized in the booklet (Attachment 1). The booklet neither covers the visual design part nor first, second and third page as table 6 below.

Table 6. Booklet organization plan

The Booklet		
Page	Subject	Content
First page	Cover page	Project's and joined institutes' logos: ➢ WastED, Haaga-Helia University of Applied Sciences ➢ Turku University of Applied Sciences ➢ Sykli The Environmental School of Finland ➢ European Union – European Social Fund Name of the booklet (agreed later within WastED)
Second page	Thank you page	(agreed later within WastED)
Third page	Welcome page	Introducing WastED project and joined institutes, introducing the booklet and its goals.
Fourth page	Table of contents	Have list of ➢ Themes ➢ Teacher's papers ➢ All class's activities
Fifth page onwards	Content of the booklet	Following structure of the booklet: ➢ Waste Introduction Theme o Teacher's Paper o Class's Activities ➢ Waste Management Theme o Teacher's Paper o Class's Activities Topics under Teacher's Paper, and Activities under Class's Activity can be found in figure 13 or in sub-chapter 4.2.1 above.

5 Product finalize (PT3)

This chapter presents the interviews conducted for the purpose of improving the product for target market. Those suggestions from interviewees will be taken into account in order to finalize the product.

5.1 Feedback-Interview

This sub-chapter provides information related to the interview including interview background and interview process. Interview result will be covered in next sub-chapter.

5.1.1 Background of the interview

Since the booklet is created mostly based on literature review via secondary research, interviews will help to improve the booklet in terms of practicality.

Potential interviewees were reached by phone calls, asked for the interview. Five among fifteen contacted people have accepted to join. Then translation of Booklet into local language was sent one week before the interviews so that interviewees would have time to read and take notes. The author aimed to have a mix group of principal, nurse, teachers in different subjects and years of experiences to have diverse feedbacks from different viewpoints.

Table 7. List of interviewees

Title	Name	Current position	Primary School
Mr.	Pham, Quang Khai	Principal	Bui Thi Xuan
Ms.	Tran, Thi Huyen	3rd grade teacher	Nguyen Thai Hoc
Ms.	Tran, Thi Ha	5th grade teacher	Nguyen Thai Hoc
Ms.	Dang, Thi Mai	Physical teacher	Hoa Binh
Ms.	Dang, Thi Mai	Nurse	Bui Thi Xuan

Mr. Pham Quang Khai started teaching as a math and physics teacher in senior high school for 2 years. He worked as a vice principal from 1980-1985; since 1985, he has been appointed to be principal of Binh Minh Primary School, Trung Vuong Primary School and recently moved to Bui Thi Xuan Primary School, which are all top rating schools in Vung Tau city.

Ms. Tran Thi Huyen has been teaching in Nguyen Thai Hoc Primary School for 18 years, before that, she had another 12 years teaching in other primary schools in different cities.

Ms. Tran Thi Ha has 25 years of teaching 3rd, 4th, and 5th grades in Nguyen Thai Hoc and other two primary schools in total.

Ms. Dang Thi Mai is responsible for 2nd-5th grade physical education, started from 2013

Ms. Dang Thi Minh has just started working as a nurse taking care of pupils' health issues at school in 2012

With high experience in teaching, Mr. Pham is able to provide an overview for the course as a manager and a teacher. On the other hand, as head classroom teachers, Ms. Huyen and Ms. Ha are expected to give valuable feedbacks for the course load and new teaching methods. While Ms. Mai and Ms. Minh are quite young and less experienced than the other three, Ms. Mai has with children more physical activities and Ms. Minh is closed to them as a supporter, they will give more comments on practical communicating and getting along with children in games.

5.1.2 Interview process

The interviews were conducted via Skype voice chat as following schedule in table 8.

Table 8. Interview schedule

Interviewee	Date	Helsinki time	Vungtau time
Mr. Pham, Quang Khai	9th April 2014	6:00-7:00am	10:00-11:00am
Ms. Tran, Thi Huyen	10th April 2014	6:00-7:00am	10:00-11:00am
Ms. Tran, Thi Ha	11th April 2014	6:00-7:00am	10:00-11:00am
Ms. Dang, Thi Mai & Ms. Dang, Thi Minh	12th April 2014	10:00-11:30am	02:00-03:30pm

Fortunately, because of the different time zone, the thesis author was able to conduct the interviews outside office hours due to the full-time working job. Generally, the interviews were conducted in informal atmosphere with flexible conversations. Interviewees were invited to give comments in open discussions form, under three topics: waste-management content, teaching method and booklet design.

Interview with Mr. Pham Quang Khai

It took around 5 minutes to explain the project, booklet and its purposes since Mr. Pham asked to know more about the background of the research. He shared his point of view and raised concerns related to challenges when implementing the project. However, he was impressed by the concept of the course and booklet since it has been the first known material providing environmental education for primary schools in such a creative way and the idea how it approached the children through class activities and new teaching methods. Then we have around thirty minutes to go through three topics and the interview ended 15 minutes earlier than planned.

Interview with Ms. Tran Thi Huyen

It was a nice experience interviewing Ms. Tran Thi Huyen. She was quite calm and open minded. She had a little understanding of the three given themes (waste management content, teaching method and booklet design) and how she could help with that. Therefore, we went through each theme, I clarified and explored each theme by specific questions to open the discussed issues. I have gained a lot of additional information

related to the status of waste-management education of the case country. The interview ended as scheduled.

Interview with Ms. Tran Thi Ha

Even though there was internet problem, the interview ended successfully. Ms. Tran Thi Ha understood the idea of the project and the booklet quite well so we went directly to the interview theme. As a head teacher, she mainly gave comments on the waste-management content and how to structure the lesson plan. We also discussed a little bit about timing for lessons in Vietnamese primary schools. Although she was asked for opinions on the booklet design, there was no suggestion given since she has not thought of this aspect. The interview time was almost one hour as planned.

Interview with Ms. Dang Thi Mai and Ms. Dang Thi Minh

Unfortunately, Ms. Dang Thi Mai could not make it for the interview and Ms. Dang Thi Minh was not able to connected to Skype, we had a discussion on Facebook instead. Ms. Minh did not have so many comments or suggestions for the booklet due to her limited knowledge of the field. The interview was not as successful as expected and only last for twenty minutes.

5.2 Interview result

Since interviewees do not speak English, the result was translated by the author. Interview result will be generated under three themes instead of divided based on interviewees.

5.2.1 Waste-Management Content:

This sub-chapter presents findings, opinions, and feedbacks on the waste-management content of the booklet. In general, given information in the booklet is not so difficult for primary teachers even though waste-management education is considered as a new field, and has practical issues. Following are given suggestions:

- Having some more **excursions** added as separate activities.

- Exploring more about **hazardous waste** on the topics of: how to recognize, can it be handle by children, how to handle, what its danger is, how it affects human health…
- Adding lessons of **compost waste**, understand about composting, its function and usages.
- Have **summary ending** for the lesson in each activity.
- Since contact classes have one week break period in between, teachers should **create a link or connection to the next lesson**.
- The booklet can include a **variety of activities and point out which activities suits which grade**.
- The last waste group, "**construction waste**", in waste-classification table (table 4) is not popular in target country so it was suggested to be **dropped**.

In comparison with the lessons covered in compulsory text books in local country, the content of this course is much deeper, wider and more practical together with less heavy class's activities.

5.2.2 Teaching methods

This sub-chapter presents findings, opinions and suggestions on the teaching methods used in the course.

Overall, positive comments and feedbacks were given for the teaching methods used in the course. They were highly appreciated since they are different and creative compared to traditional teaching methods which have been used and in the process of changing and improving. Hence, the material was told that it is the right time for implementing the course while testing and applying new pedagogical methods.

Besides, timing for each class activity was suggested to be reconsidered due to the local educational system, which regulates 40 minutes for each lesson.

5.2.3 Booklet design

Unfortunately, all of the interviewees refused to give suggestions on booklet design due to their limitation in designing and art. There was only one feedback for the waste-classification table added in the teacher's paper of waste-management theme that it was quite heavy to read.

5.3 Finalizing the product

Based on the interview result, the product is improved and redesigned (table 9). Explanation is given for other comments which are not possible to approach in this thesis.

Table 9. Product improvement

Suggestions from interviews	Improvement in the product	Argument base for improvement
Having summary ending for the lesson in each activity	Adding in each class activity 1 more step of generating all information that has been discussed in the lesson	Even though there are "playing" activities for the purpose of learning, children must still be made sure that they have learned something after that so a summary stage will be helpful.
Create a link or connection to the next lesson	Adding in each class activity 1 more step of linking and connecting the ongoing lesson with the next one, together with starting step 1-pre-preparation of coming activity	In order to have an effective course, all information and action stages have to be built on each other. Pupils must be able to link these activities in order to have a big picture which the course tries to communicate. Break periods between contact classes might become obstacle for the mental development. Besides, this step also helps to remind teacher what needs to be

		prepared for next lesson.
Timing	Activities which are around 1 hour will be extended to 1 hour and15 minutes. Activities which are around 2 hour will be kept as they are.	Since additional steps are added to the activities of each lesson, it may require more time. Besides, fixed time for one lesson in local school is 40 minutes. Hence, timing of this course's lesson needs to be matched with the regulation so that the schools are able to add the course to the class's schedule.
Waste-classification table	Transferring the table to flash cards (Attachment 2)	The author totally agreed with the feedback that waste classification in table form was heavy and even not attractive to read. Hence, new layout and design was searched to make it more user-friendly as well as dropping the "construction waste" group.

Other suggestions such as excursion lesson, hazardous waste theme, compost waste topic and a variety of activities for different grades will be added in further research and development of this thesis due to the course's limited time requirement from WastED project.

6 Discussion

This chapter summarizes the main results of the thesis, gives author's opinions on what should be the next steps to take before implementing the course, some suggestions for the implementation as well as further development of the course. The chapter and the thesis end with author's personal learning evaluation.

6.1 Key result of the thesis

This sub-chapter presents the key finding of the thesis. The project carried out the objective of "Design a Solid Waste Management Course for Primary School focus on Reduce-Reuse-Recycle" for WastED, a project of exporting Finnish advanced education and waste management to other countries. All project tasks have been achieved, which are building a theoretical framework, creating & designing the course in booklet layout based on prior literature review, and finalizing the product with improving suggestions from local-teacher interviews.

Different and variety of sources have been used for the secondary research. Books are main resources while internet sources are used for the purpose of updating methods and information from the books. For the waste management field, managing system has not been changed a lot while educational pedagogy have been continuously improving and developing. Besides, the study also shows that the choice of teaching methods and the way of packing the information can make huge differences in the efficiencies and effectiveness of absorbing and understanding the lessons.

Final outcome of the thesis is a demo waste-management-course booklet (attachment 1) and waste-classification flash cards (attachment 2). Core content of the booklet was created & designed carefully. However, in order to be complied with other materials of WastED project's, it requires development of assessment methods as well as professional WastED's designed template.

6.2 Next steps for implementing the course

As mention in sub-chapter 1.4 - Scope of the thesis, since this thesis only covers theory framework, product design and teacher's materials, there are several steps that have to be taken in order to complete the educational package.

There is need of developing **assessment methods** for the course, especially since this course is for children. The assessment should help to find out how have children learn

and improve the knowledge as well as skills during the course; what should be improved, added or taken out.

Some activities require added **materials for children** for example Spy's Note in A1 – This will be developed separately with this thesis by the author.

Even though the booklet now has a beta design, it still needs **professional visual design** to comply with other materials of WastED project's in order to be sold.

6.3 Implementation-support suggestion

This sub-chapter will not give a full implementation plan for the course; it only presents some suggestions of the author which might help the implementation.

Human Resource: The ideal personnel for the course is 1 adult per 15-16 children. If the class has more than 16 children, main teacher should consider having assistant(s) to run the lesson effectively since most of the lessons have group works including some physical activities.

Facility: The school should invest in a special room for the course, decorated colorfully and creatively with recycled stuff, movable facilities, wide enough area for physical games, place for sharing ideas, bookshelf, children's hand-made products ext., suiting the idea of the course and supporting new creative learning and teaching methods.

Waste management system: In order to apply this course, the school should change its waste management system, complying with the purpose of implementing the course: having different storage containers for common waste: glass, metal, paper & cardboard, plastics, organic, hazardous & mixed waste.

6.4 Further research & Development

Partner companies: The school can make contact with local environmental companies to hold excursions for children to have practical experiences, explore more what have been learn from class.

Other themes or topics: Waste management is a huge area so there are lots of potential topics which could be developed and added to the course: *hazardous waste* and *compost waste* are examples. Even though they are two categories of waste classification, they are complicated topics which should be taught as separate themes other than combined with other topics; or *natural resources* which introduce children where things around them come from and the natural raw materials used for production are not unlimited.

Different activities for different classes: The course can have various activities for grade 1 to grade 5, which are classified in a table to show which activities are suitable for which grade.

Website: a website developed for the course to publicize and share all the course information as well as creative ideas so other people can access this or pupils can look at it if they miss a lesson. The website also helps to express the course's ideas wider and faster, can be a place for schools to exchange and sharing information as well as experiences.

Competitions: can be hold among classes within the school or among schools in the city to push improving the action in practice.

Course in English: First the course will be taught in Vietnamese, later on, it can be considered to be implemented in English so the children can on one hand learn about waste management and on the other hand improve their English. However, it requires teachers with knowledge of waste-management vocabulary in English and children have to have a specific level understanding of English.

Glossary of waste-management field can be added at the end of the booklet for supporting teachers.

6.5 Personal learning evaluation

Doing my thesis on the topic of "Design a Solid Waste Management Course for Primary School focus on Reduce-Reuse-Recycle" is a great opportunity for me since I always want to develop my future career in waste-management field. I have gained deep knowledge not only in waste-management field but also in primary pedagogy.

It quite surprised me that waste management methods have not changed so much since the last fifty years and disposal has been, still, the most common waste treatment. Even though every country talks about environmental impacts and reducing landfill, not so many countries actually put their effort on it. Since waste treatment methods were created a long time ago, in my point of view, it very soon needs a revolution to catch up with the development of society and economics.

In addition, I also learned how to adapt waste-management system from developed countries to developing countries in suitable ways to sell an educational product/service in emerging markets.

However, it is a challenge for a business student starting to learn about waste and waste management system as well as educational pedagogy. Yet, they are my interests so it motivates me to read and learn. Besides, since this thesis was established together with the WastED project which means that the thesis time management should more or less followed the project's plan, this affected the thesis-writing and presenting schedule.

Again, it is a great opportunity for me to create networks to experts in waste management as well as primary schools in target country.

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Attachments

Attachment 1. Demo Booklet

Let's learn about our WASTE

1/ 27 Waste guide

April 2014

Helsinki, Finland

Waste Introduction

What is waste? What are the effects & consequences of waste? How is waste handled?

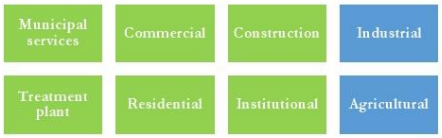
In this theme, pupils and teachers will learn basic definition of waste concepts as well as the impacts of waste on human and environment. By participating in the lessons; children appreciate how their decisions in daily activities can affect the environment.

2/ 27 Waste guide

Teacher's paper

What is solid waste and municipal solid waste?

Solid Waste is simply defined as substance or object, normally solid, which is discarded or required to discard, arises from human and animal activities. There are 8 source groups of solid waste:



Solid waste which is collected by municipalities is known as **municipal solid waste** whether it is food wraps, beverage containers, and leftover food, shower bottles, old magazines, or old electronic devices and so on.

Municipal solid waste (MSW) mostly comes from households (so-called residential waste), accounts for 60%-90% total volume (2011), but it also comes from institutes, construction sides, municipal services, treatment plants, commercial businesses (but not from industrial and agricultural businesses).

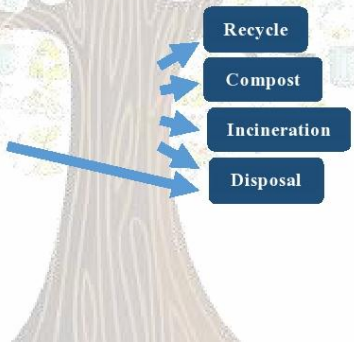
Key facts of municipal solid waste

- Increased 150%-200% in 5 years, 2003-2008
- Vietnamese generate about 1.2kg per person per day, 2011
- Predicted to be 44milion tons in 2015 for whole country

How is municipal solid waste managed?

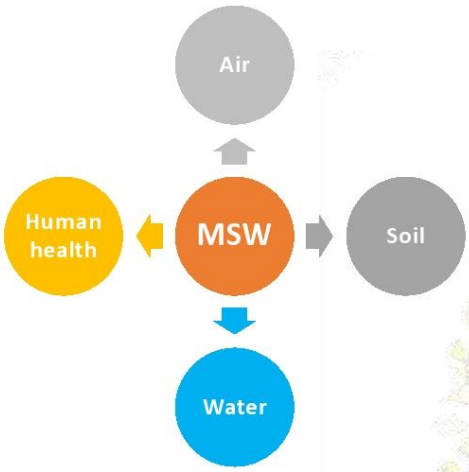
Solid waste generated by citizen is collected by either waste collecting companies or individual garbage-collectors who work for the People Committee of cities/ districts/ wards. This waste is gathered in a large amount and stored in specific places for further transporting. Huge amount of waste from gathering points are transported in big trucks to processing factories or mostly to landfills. Waste which is processed will be sorted for: recycling, composting, incineration and disposal.

Municipal solid waste in Vietnam is managed as in the figure below.



Effect and Consequence of Waste

In the early time, the earth itself had the power to absorb, dilute, transform, reduce and balance the impacts of animals' and human's disposal. However, along with the development of human society, waste has been increased dramatically, from industrial factories, agricultural mass-production field, heath services, mining and construction, daily-life activities and so on, which **exceeds the self-recovery ability of the planet**. Poorly stored food wastes or organic wastes are ideal places for rats, flies and other diseases.



Air pollution

Solid waste, especially municipal solid waste contains mostly organic substances. Under the effect of temperature, humidity and microorganisms, organic municipal solid wastes such as food waste, garden waste, paper, textiles, resins, bitumen,... are decomposed, produce gases: mostly CH_4 – 63.8%, CO_2 which are the main gases causing **greenhouse effect**.

Organic substances are decomposed during the transportation and storage process will lead to the **occurrence of odor** polluting the environment such as urine, foul, rotten egg, rotting cabbage, rotten fish smell...

Besides landfill activities, **incineration treatment** method also contributes to air pollution. Burning garbage will produce **smoke, dust and unpleasant odor**. Municipal solid waste may contain compounds of Chlorine, Flo, Sulfur and Nitro which can transfer to toxic emission or corrosive effect. Moreover, if the temperature of incineration plants is not high enough or gas-collection and management system do not meet the standard, **solid wastes** will **not be completely destroyed** which produces carbon monoxide, nitrogen oxides, dioxins and furans, evaporative and very toxic substances for human health. Even though dust pollution is usually the main reason of public grievance because it can easily be seen, the more dangerous elements are the compounds such as heavy metals, dioxins and furans, on the surface of dust particles – invisible to human eye - released into air.

Effect and Consequence of Waste

Water pollution

Uncollected solid waste, directly dumped to canals, rivers, lakes, ponds, causes water pollution, water-circulation congestion; reduces the tangential surface between water and air, **reduces dissolved oxygen** (DO) in water. Solid organic waste decomposing in water releases **foul odor**, changes **water color into black** and causes **aquatic organisms impairment**.

Typically, waste landfills have proper techniques of piping, collecting canals, cisterns and treating systems for waste water before discharging into the environment. However, if landfills are not properly constructed and hygiene equipment is overloaded, **landfill-water leakage** is discharged directly into lakes causing serious water pollution. Besides, the occurrence of spontaneous landfill is also a significant source of water pollution.

Soil pollution

The solid waste can be accumulated under land in the long period causing potential danger to the environment. Construction wastes such as **bricks, tiles, glass, plastic pipes, cables and concrete ... are very difficultly decomposed in soil**.

Metal wastes, especially **heavy metals** such as lead, zinc, copper, nickel, cadmium... often occur in mining district or industrial areas. These metals **accumulate in soil and penetrate the body through food and water, significantly affect human health**.

Some types of waste which can create pollution in large extent of land are detergent, fertilizers, plant protection chemicals, dyes, paints, battery manufacturing, tanning, industrial chemicals...

The effect of plastic bags

Plastic bags are difficultly decomposed substances, when released into the environment, they take decades to a few centuries to become fully biodegradable in nature. Incomplete decomposition of plastic bags will leave debris in soil, leading to no conditions for microorganism making soil become infertile. The existence of plastic bag in the environment causes serious impacts to land since it prevents oxygen passing through land, causing soil erosion, making soil not able to hold water and nutrients.

Effect and Consequence of Waste

Human health

Poor management and disposal of solid waste is not only the cause of environmental pollution but also a great influence to human health, especially for people living near industrial or burial areas.

People living near unhygienic landfills have incidence of **skin diseases, bronchitis, and osteoarthritis pain** much higher than elsewhere... A study in Lang Son, Vietnam (2009) showed the percentage of people suffering from illnesses and diarrheal diseases, dermatology, respiratory ext. in areas affected by landfills are significantly higher than people in non-affected areas.

Landfill is another potential risk to the community working on it. **Sharp objects, broken glass, old needles... could be dangerous threats** to human health (infectious diseases such as AIDS infection...) when they are stepped on or make scratched limbs. Another issue to be considered is that a large proportion of workers picking up trash are women and children, who are the most vulnerable groups.

Two components of solid waste classified as extremely dangerous are **heavy metals and persistent organic compounds**. These compounds have the ability to **bio accumulate in agricultural products and foodstuffs** as well as in **animal tissues**, **water** and sustainable survival in the environment. This causes a series of dangerous diseases to human such as **infertility, teratogenic defects in newborns**. Besides, it also has impact on the **immune system** causing heart disease, paralysis of the nervous system, reducing the ability of blood metabolism, causing possible cancer and malformation sequel to 3rd generation.

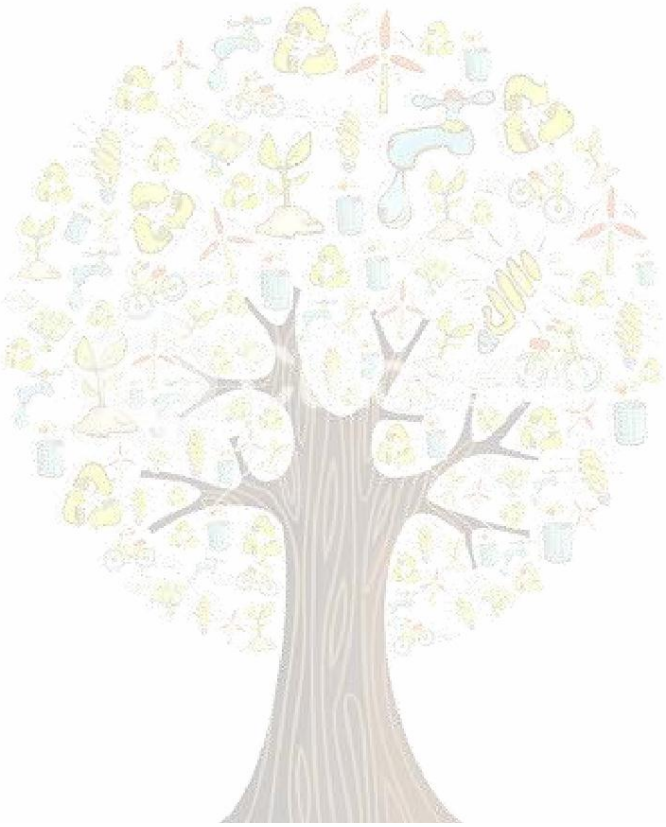
Agricultural waste, animal waste in particular, is one of the pressing problems of farmers. There are farming areas in which livestock waste pollutes air and water, soil and adverse impacts on human health. A survey was done with 113 households raising 20 or more pigs in Thai Nguyen Province, Vietnam (2008). It found that nearly 50% of households having houses 5-10m or water wells 5m - near pigsty, have the percentage prevalence of Ascaris, Trichuris, and Hookworm eggs almost two times higher than the average rate of intestinal parasitic infection of non-farmers. In addition, there is positive correlation between the prevalence of intestinal parasites and parasite prevalence in farmland.

Why waste management is needed?

- Waste management help to **prevent mentioned problems** above can be prevented while keeping the natural and living environment healthy and clean.
- It **creates jobs** for people and contributes to national economy.

Challenges of Waste management

Nowadays, societies and economies have developed rapidly leading to mass production with more and more products and waste increasing proportionally. This has exceeded the treatment capacity of waste management companies and grown faster than the development of technology. Besides, disposal or landfill has been the most common and cheapest methods for waste treatment.



Class's activity

Let's be a spy!

Objective

Encourage pupils to think about waste they produce

Activity description

Collecting waste from home
Make waste-record paper

Materials

Letter for parents: 1/ pupil (asking for their help and support for the class activity)
Glue, scissors, tape, markers, crayons
Clean trash (brought by pupils and some prepared by teacher)
Daily-life product pictures (from newspapers or magazines)
Big carton paper/ board
Waste Exploring Spy note

Time

1hour 15minutes

Skills

Observation
Critical thinking
Team work

Activities

Step1: Pre-activity

- Send out Parent letter
- Distribute Spy paper (1/pupils)
- Guide and explain the activity: Waste-Exploring Spy
  Tell children that now they are spies, their mission is noticing and recording waste produced by their friend and family members. Save the finding by writing to "Waste Exploring Spy" note
- Each of them will collect one to two clean trash items (note: avoid trash with food leftover, wet, and dangerous trash such as glass or sharp metal object for sanitation and safety reasons: paper, breakfast bag, toys…)

Step 2: Group discussion

- Pupils discuss in group of 2 or 3: What trash they collected and from where (from home, school…); how they identify garbage
- Distribute newspapers, magazines, and scissors for them to cut products familiar to them, used in everyday life

- Guide them to find out the sources of each waste they have just discussed (Product cycle: what is the original product -> from that what kind of waste will be found?)

Step 3: Team presentation

- Each team presents their research and gathers them on similar categories, sticks on carton paper

Step 4 (optional): Create art from found garbage

- Some suggestions: make a rainbow, picture of an animal, build some toys...

Step 5: Lesson summary

- One or two pupils summarize findings of the lesson
- Teacher makes the final additions or corrections
- Link the ongoing activity to and open next lesson

Step 6: Review and prepare for next class

- Implement step 1 of next activity

9/ 27 Waste guide

Class's activity

How much waste do you produce?

Objective

Raie awareness of pupils about amount of waste they generate

Activity description

Ask pupils to collect their dry waste, record and analyze amount of trash they generate in a week

Materials

A plastic bag (1/pupils)
Name tags & twist ties for waste-collecting plastic bags
Gloves (1pair/pupils)
My waste note card

Skills

Observation
Classification
Problem solving
Computation

Time

2 hours

Activities

Step 1: Pre-Activity

- Distribute: bag, name tag with twist tie, My Waste Note card (1each/pupils)
- Guide pupils to collect only dry trash, avoid trash with food leftover, wet, and dangerous trash (such as glass or sharp metal object) for sanitation and safety reasons: paper, breakfast bag, toys…
- Explain: Activities will be mainly conducted at school. Pupils will leave the plastic bag overnight in class. It's good if they can bring the trash they produced from home, but if they cannot, they can record them to the note card instead.
- Guide pupils to record and fill the note card: All waste items they produce must be recorded in "My Waste Note" including collected and uncollected waste items

Step 2: Gathering the result

- Pupils predict and estimate how much waste in average they have generated within a week and write on the board
- Write national average waste amount generated per person per day on the board and ask pupils to compare with their result

10/ 27 Waste guide

Step 3: Exploring the topic to family and school and society waste

- Pupils calculate how much waste their family (based on family member) produce a day – a month and a year
- Write number of pupils and staff of the school on the board
- Pupils calculate how much waste their school generate per day – month – year
- Write number of citizens in the city on the board
- Pupils calculate how much waste their city produces per day – month – year
- Help pupils familiar with measurement units, compare and associate to objects they know already

Step 5: Lesson summary

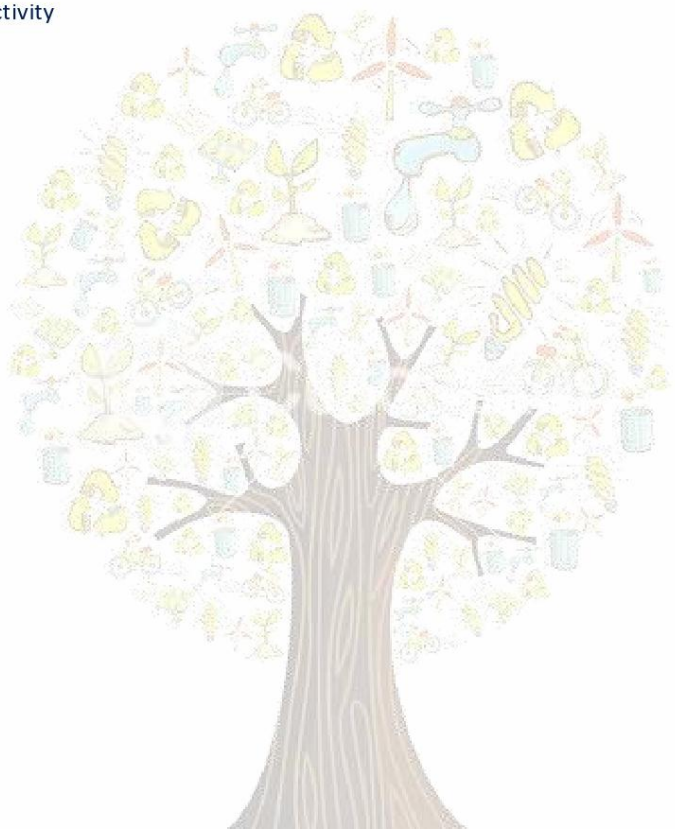
- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections

Step 4: Arouse children's curiosity

- Link the ongoing activity to and open next lesson
- Open for pupils to think and prepare for next class: what has happened to those wastes?

Step 6: Review and prepare for next class

- Implement step 1 of next activity



Class's activity

How does our waste affect others and environment?

Objective

Raise awareness of pupils about effect and impacts of waste on the environment and human

Activity description

Interview adults and make reports on waste impacts

Materials

Waste Report note
Board & punches

Skills

Presentation
Critical thinking
Communication
Research

Time

Depend on the numbers of pupils in class: 30 minutes per pupil (2 minutes presenting and 10 minutes for discussion)

Activities

Step 1: Pre-activity

- Distribute "Waste Report" to pupils
- Highlight that they are now 'journalists'
- Their job is interviewing their parents or relatives how they see waste affects the environment and community
- Pupils conduct the report within a week

Step 2: Class discussion

- Pupils will bring the report and present in front of the class
- Open discussion based on pupils' reports
- Leave room for other pupils' questions

Step 3: Raising children's consciousness & responsibility

- Save all reports by stick them on the board
- Relate them to the facts and comparison of amount of waste that each of them in person and the whole community generate from last time
- Emphasize and relate daily-produced waste of every single person that contributes to the environmental impacts; hence, small changes from individual can lead to a huge effect, can be positive or negative based on our actions.

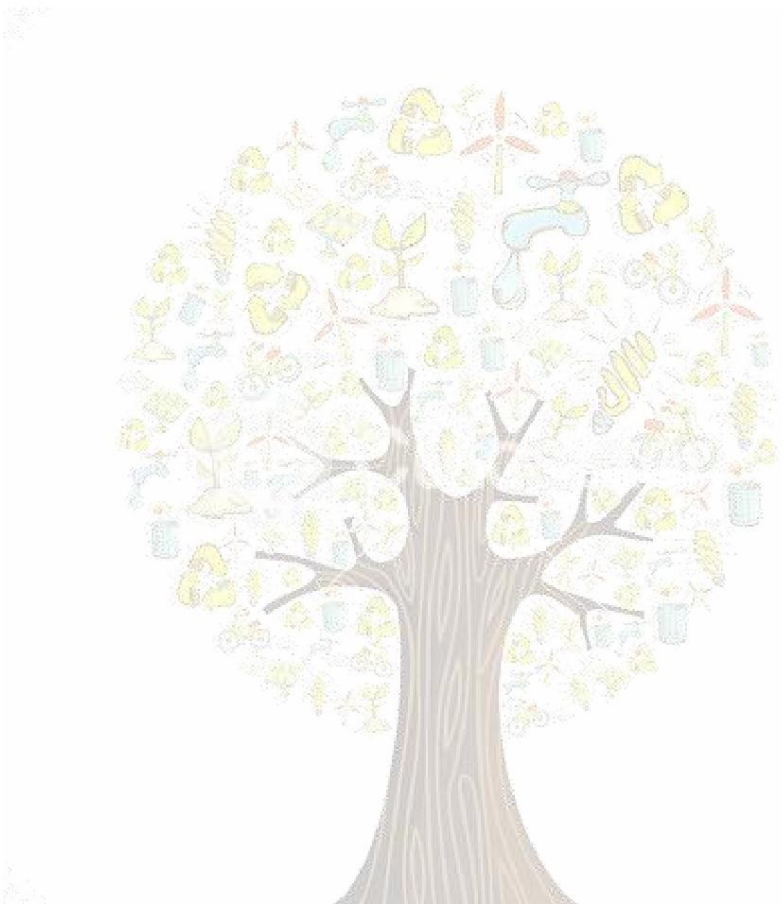
Step 4: Encourage children to think and question how and what they can help

Step 5: Lesson summary

- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections
- Link the ongoing activity to and open next lesson

Step 6: Review and prepare for next class

- Implement step 1 of next activity



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Waste Management

What are 3Rs? What can be done to improve the waste treatment?

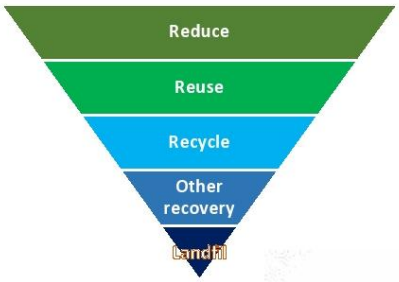
In this theme, pupils and teachers will learn more about waste management in term of reducing, reusing and especially about recycling waste. Besides, through the course, children are guided how to treat and sort waste at source in order to support the waste treatment and recycling system.

14/ 27 Waste guide

Teacher's paper

What is Waste Hierarchy?

Waste hierarchy presents different waste treatment methods placed in an inverted triangle, in the order of less impact on the environment and human society.

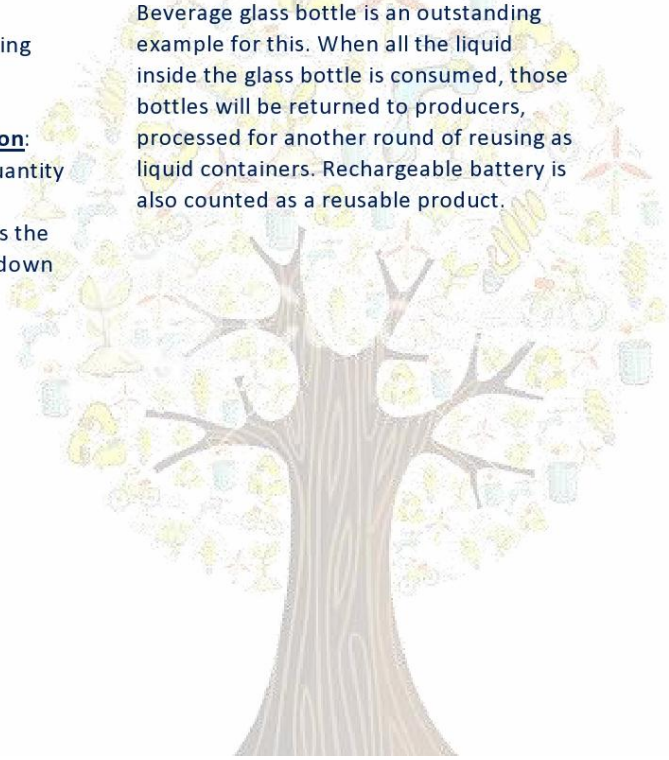


What is 3R?

3R stands for
Reduce – Reuse – Recycle
Three initial advised stages for treating waste.

Reduce-Prevention-Source Reduction:
Reducing waste at source both in quantity and quality (like toxic chemical, dangerous gadgets or apparatus...) is the significant factor that helps cutting down the pressure on waste management for all stages (handling, collecting, storing, treating, disposing) and lower the costs as well as environmental impacts. Besides, reducing waste at source is the simplest way which can be applied and done by any people (housewives, children, workers, managers...) at any time (i.e. at the beginning, during and at the end of manufacturing process including packaging and delivering) in any place (household, schools, companies..).

Reuse:
Reuse means that products, after the first-time use, may lose total or a part of its value. However, without or with little changes, their value could be recreated. Beverage glass bottle is an outstanding example for this. When all the liquid inside the glass bottle is consumed, those bottles will be returned to producers, processed for another round of reusing as liquid containers. Rechargeable battery is also counted as a reusable product.



How can you help reducing and reusing waste?

Some examples for reducing and reusing waste:

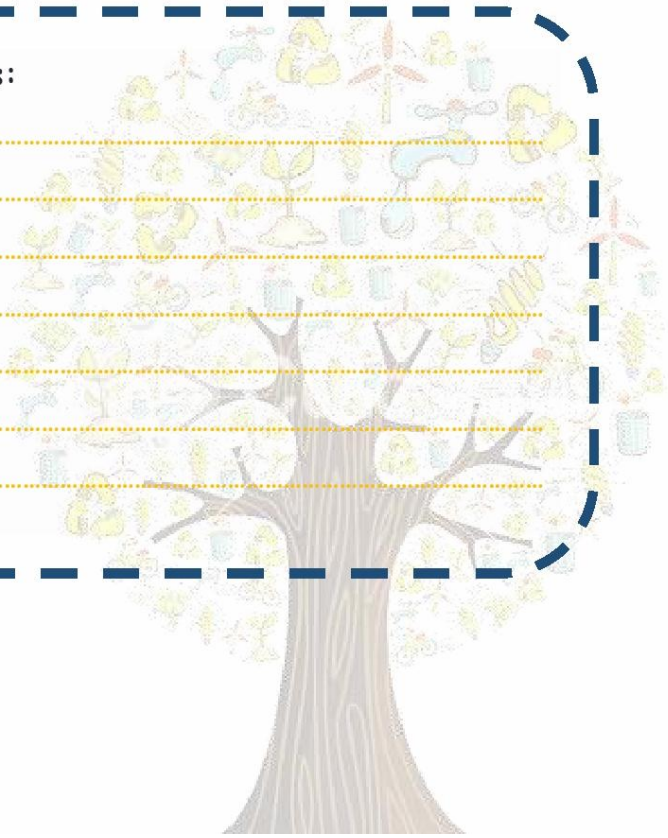
- Avoid using one-time-use products like paper or plastic cups, dishes, spoons…
- Bring your own bag to supermarkets
- Donate or sell your old items instead of throwing them away
- Reuse plastic or glass bottles or containers to store food or ingredients
- Avoid printing only one side on papers and try to print both sides of the paper

What are the challenges of Reduce and Reuse?

Again, it requires changes from human's habits and attitude in daily routine, which is difficult to do in a short time, while the effects of over waste-producing take longer time to be visible to individual waste makers.

For most businesses, profit is the main driver for the operation. Even if they are aware of the situation, it's also difficult for them to change because buyers do not ask for it and stockholders demand high return-on-investment.

Add your own ideas:



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Recycle:

Recycling takes place when the product is at the ending stage of its life cycle. Those products, after being separated, are remanufactured to become new products, or raw materials, which help to solve the problem of natural resource limitation. It can be very simple like recycling packing boxes or toilet-paper roll cores to make some house-decoration or toys for kids which we can do at home. Or it can be as complex as recycling mobile phones or cars like Nokia, Nissan...

How does it work for Recycle?

Recyclable items such as paper, aluminum, glass, carton, PET & HDPE plastic are collected and gathered at central storage (In Vietnam, this has been done by individual collectors). They will be sold or returned to manufactures where after being processed, those items will become material to produce new products or original products (such as glass or plastic bottles).

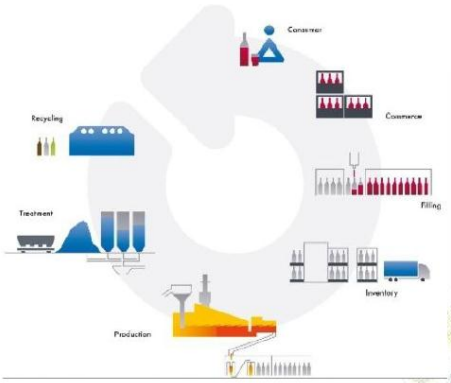
Metal (Steel & aluminum)

Municipal recyclable metals commonly are aluminum and steel, which can be sorted based on types of original products or tested by magnets. Aluminum often exists in: wrapper, aluminum plates, can, garden, furniture, aluminum containers, foils, construction materials...; while steel is usually found in: motors, tools, food cans, framing material, nails, construction beams and girders... New aluminum and steel product which are made from recycled items will **save 95% energy compared to processing new ones**. Seeing those as raw materials, we can continue producing cans, furniture, tools ext. and there is **no time limitation for aluminum recycling**.

Glass

There is variety of glass types and ways of classifying glass. Following the Finnish municipal sorting waste guide, packing glass should be separated into **colored and clear**. Glass containers if not reusable because of exceeding reusing cycles, will be crushed before melted & molded into new products (such as bottles and jars or other purposes like decoration) due to economic reasons: reducing storing space and saving shipping costs. Similar to metal, especially aluminum, "glass does not degrade through the recycling process, so it can be recycled again and again".

Life cycle of recycling

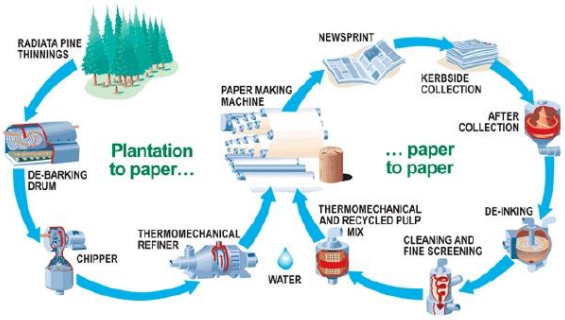


Paper & Cardboard

Since paper and cardboard has been the **second largest components of municipals solid waste**, recycling papers plays a significant role in helping to reduce landfill and forest loads as well as energy consumption in processing new paper and mill.

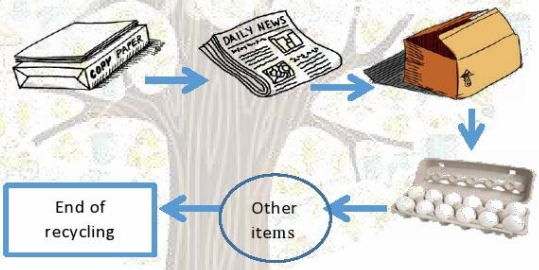
Key fact

Every ton of paper recycled saves:
More than 3.3 cubic yards of landfill space
& 17 trees
& 7 000 gallons of water
& 463 gallons of oil
& enough energy to heat an average home for 6 months (EPA 2005)



However, since the **quality of fibers in paper is shortened and weakened** each time it goes through the recycled processed, average recycled times for recycling paper are five to seven. During recycling, papers are deinked and turned back into pulp in order to produce another product(s) which required lower fiber quality compared to the original ones. When fiber becomes too short, producers have to add virgin fiber to hold it together.

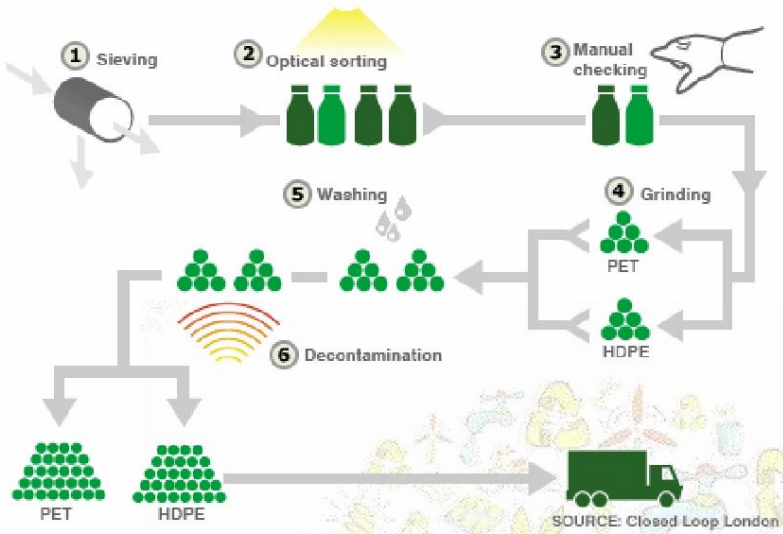
An example of paper product cycle is:



Plastic bottles

Recycled plastic which has PET sign, is usually found from plastic container of soft drink, some beverages. Returned plastic bottles go through the process of being crashed, melted and shredded into small pieces which are then used as input material for new products such as clothes, gloves, jacket, bottles, containers, vehicles' parts, carpets, fiberfill and many more.

Another plastic type is HDPE, "used in milk, water, detergent, and motor oil containers, can be remanufactured into trash cans, bathroom stalls, plastic lumber, toys, trash bags, and hair combs". Recycling **5 plastic soda bottles help to produce one XL T-shirt**.



How can you help in recycling waste?

Some examples for recycling waste:

- Buying recycled products
- Clean and sort waste at source to help reducing disposal of recyclable items in landfill and increase the rate of recycling
- Propagandize to other people to get to know and take action

Add your own ideas:

Class's activity

Earth saver-Reduce

Objective

Encourage pupils to create idea and take action of reducing waste at source

Activity description

Assess the result of improvement action from Waste Note; brainstorm of reducing waste at source

Materials

Waste note
Earth-saver Ideas Paper
Big carton paper
Star stickers
Markers
Flipchart papers
Carton paper
Certificate for game awards:
- Team has the most ideas
- The most applicable idea
- The most creative idea

Skills

Brainstorm
Team work
Problem solving
Recording
Assessment
Comparison
Analysis
Presentation
Info generation

Time

2 hours

Activities

Step 1: Group work & Brainstorm

- Divide pupils into 3 teams
- Distribute their saved Waste Note & flipchart papers
- Each group will create ideas on how to reduce their waste, recoded last time on "Waste Exploring Spy" (Activity 1) and "My Waste Note" (Activity 2)
- Generate all ideas they have into a flipchart paper

Step 2: Presentation & sharing ideas

- Each team will present one of their ideas at a time but ideas shouldn't be repeated: Team A -> Team B -> Team C -> Team A -> Team B -> Team C -> ….
- Teachers take note on a board or carton paper
- Game ends when pupils finish their idea suggestions

Step 3: Give awards

- Team has the most ideas - The most applicable idea - The most creative idea

Step 4: Apply idea to practice

- Distribute the Earth-saver Idea note
- Tell pupils to pick ideas that they like and possible for them to do and write down to Earth-saver note
- Tell them from now on try to take their ideas to action and guide them to record their own improvement
- Later on when pupils do it successfully, they can write their name next to the ideas written down by teacher on the cardboard and share their story for the class, they also get one star or each action they have done

Step 5: Lesson summary

- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections
- Link the ongoing activity to and open next lesson

Step 6: Review and prepare for next class

- Implement step 1 of next activity

Earth saver-Reuse

Objective

Encourage pupils to create idea and take action of reusing discarded items

Activity description

Brainstorm possible reusing options
Create useful objects from discarded items

Materials

Crayons, double-side tape, scissors, 1-2 carton paper(s)
Clean and dry ice-cream sticks or small carton container
Junior newspaper or magazines which have icons/ pictures or their own pictures
Watercolors and brushes
Color-papers with glue

Skills

Creativity
Handcraft

Time

2 hours

Activities

Step 1: Pre-Activity

- Guide pupils to prepare clean and dry ice-cream sticks or a small carton container, newspapers or magazines which have icons/ pictures that they like or their own pictures. (With their own pictures, tell them to ask parents beforehand if it's ok to cut the picture to smaller pieces)

Step 2: Check status of reducing waste

- Guide them to share, compare and assess how far they have done for reducing waste according to their Earth-saver note: what are successful, what are challenging, what need to be changed, what need to be improved?
- Give star or each action they have done

Step 3: Introduce Reuse

- Introduce children that we do more and better not only on reducing waste but also reusing them
- Discuss and ask children if they have been reusing discarded items without notice
- Encourage and motivate them to continue doing that

Step 4: Introduce the hand-made activity

- Divide pupils in to small groups: 2-3 pupils per group
- Distribute for each group: crayons, double-sided tape, scissors, 1-2 carton paper(s), junior newspapers/ magazines if they don't have
- Tell them that today they will make a surprising book-marker for their mom or dad or both from discarded items

Step 5: Hand-made product

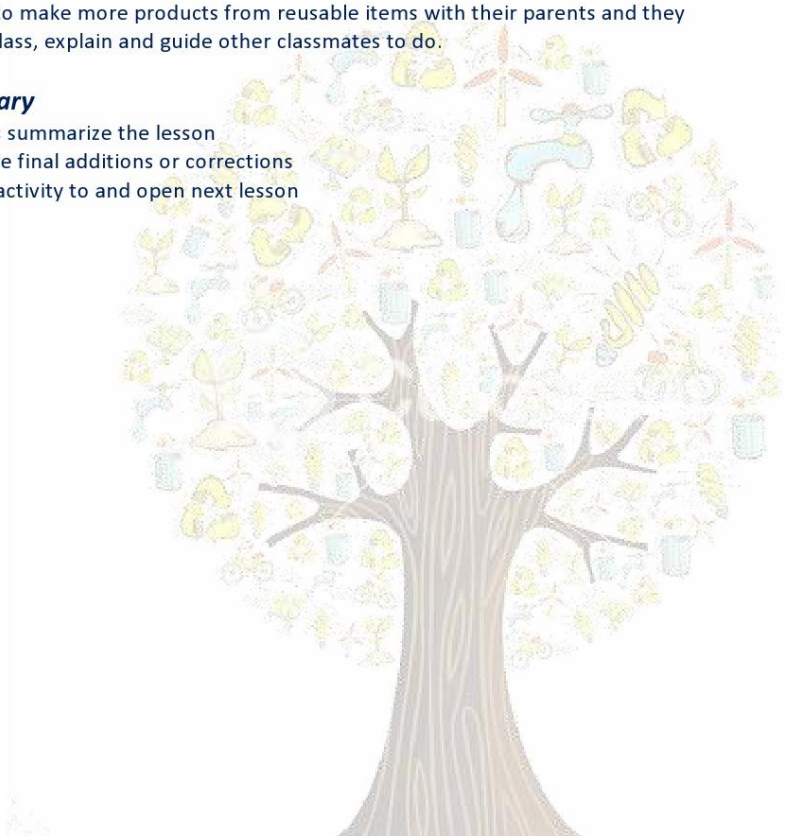
- Pupils cut out the stickers/ picture that they like from the magazines or newspapers or their own picture
- For the one who have carton boxes, guide them to draw, cut out a rectangular with four rounded angles.
- Pupils can also draw and color sticker themselves on carton paper and cut them out
- Distribute watercolors and brushes
- Pupils color ice-cream and carton stickers with watercolors
- Distribute color-papers with glue
- Pupils can cut color-papers to long lines then paste it to the ice-cream and carton stickers
- Pupils can write on cut newspapers/ magazine icons: I love mom, I love dad…
- Paste those to ice-cream and carton stickers
- Teacher helps pupils to check their bookmarkers

Step 6: Handmade product as a present

- Tell them to give those bookmarkers to their parents as a gift after the class
- Encourage them to make more products from reusable items with their parents and they can bring to the class, explain and guide other classmates to do.

Step 7: Lesson summary

- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections
- Link the ongoing activity to and open next lesson



Class's activity

Earth saver-Recycle

Objective

Help pupils recognizing the differences of materials and learn to sort them; help pupils understanding the recycling process of products

Activity description

Sorting game and present the product cycle

Materials

4 bins, pens & crayons
Stuff made of Paper, Glass, Plastic & Metal
Plastic bottle life-cycle paper: 1 per pupils
Paper, Glass, Metal product-life-cycle paper: 3 copies in big size

Skills

Discussion
Observation
Classification
Team work
Presentation
Communication

Time

2hours

Activities

Step 1: Pre-Activity

- Place 4 bins: Paper, Glass, Plastics, and Metal
- Place stuff made of: Paper, glass, plastics, metal on the floor; gather pupils around

Step 2: Lecture

- Explain to pupils how different waste items can be recycled into new products
- Highlight the importance of sorting those before they are recycled

Step 3: Learn to differentiate

- Ask pupils to look at the materials say what are the similarities, differences. Compare their colors, textures, size, weight…
- Move the items around and ask 1 pupils to put them to right bins (be careful in handling glass and metal materials)
- Ask pupils if they know which other products are made from those materials

Step 4: Plastic product-life-cycle

- Distribute: Plastic bottle life cycle paper
- Explain to them more detail of recycling stages in the process
- Guide them to revise the process by coloring pictures of plastic-life-cycle in the paper

Step 5: Group work

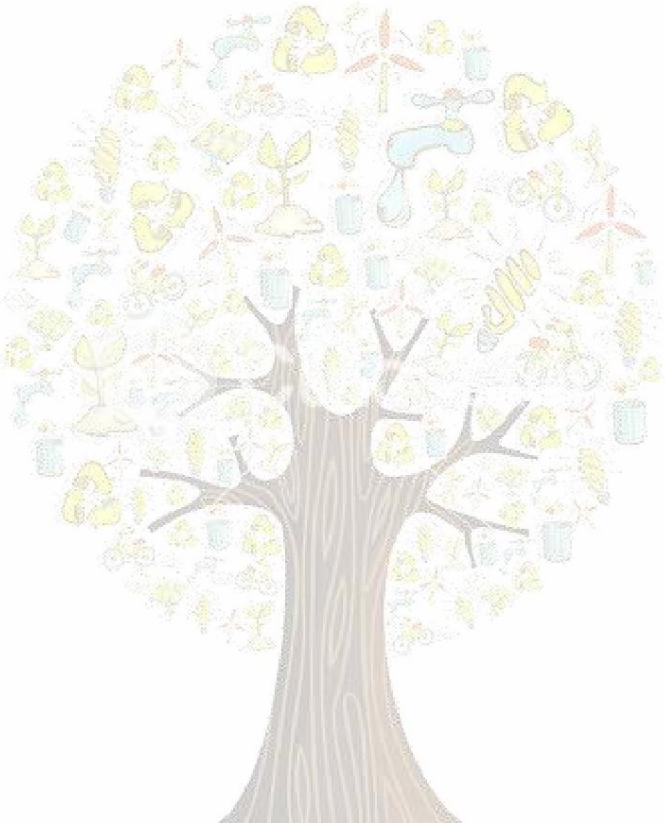
- Divide class into 3 teams
- Distribute for each team one topic: Paper-Glass-Metal product life cycle; 1 pen/pupil
- Pupils discuss in group: what happens in each stage of the process according to the picture, then write down the explanation next to the picture – Teacher will guide and tutor pupils

Step 6: Presentation

- Each group presents their part in front of the class
- Saving 4 product-life-cycle paper by sticking them on the wall

Step 7: Lesson summary

- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections
- Link the ongoing activity to and open next lesson



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Class's activity

Sort your waste

Objective

Pupils learn to sort waste at source, further activity of Recycle

Activity description

Classifying waste game

Materials

Trash bag and waste note card from earlier activity
Waste classification topic prepared on Power Point or carton board
Waste-classification group stickers
7 Bins:
- 1 carton boxes for paper & carton trash
- 1 small plastic bin with bio-bag for bio waste
- 1 bigger plastic bin for mixed waste (energy and landfill waste – apply for Vietnam because of the waste-management structure)
- 1 (clear) plastic bin for hazardous waste (ex: battery)
- 1 bin for metal waste
- 1 bin for glass waste
- 1 bin for electrical waste

Several waste samples per category (see more from flash cards)
Game awards

Skills

Classification
Team work
Physical exercises

Time

1hour 15minutes

Activities

Step 1: Pre-Activity

- Remind children about recycling activity and 4 types of recyclable waste, learned from last time
- Related those 4 types of waste to waste note that children have before to see that there are more waste types beside those 4
- Distribute waste-classification stickers and bins/ boxes
- Guide pupils to paste those stickers to bins/ boxes

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Step 2: Sorting organic – mixed – battery waste – Group work

- Divide class into group of 3-4
- Place a number of organic, batteries, burnable and landfill waste samples for each group
- Ask them to sort the waste into 3 groups: Food, Battery and Others

Step 3: Lecture

- Check the result and clarify to them that 3 sorted groups are also corresponding to 3 groups of waste: organic waste, hazardous and mixed waste – explain a little bit in detail
- Open a discussion for pupils what other things they know will belong to those 3 groups
- Generate 7 waste groups that children have learn: glass, organic, hazardous, plastics, metal, paper and cardboard, mixed

Step 4: Sorting game

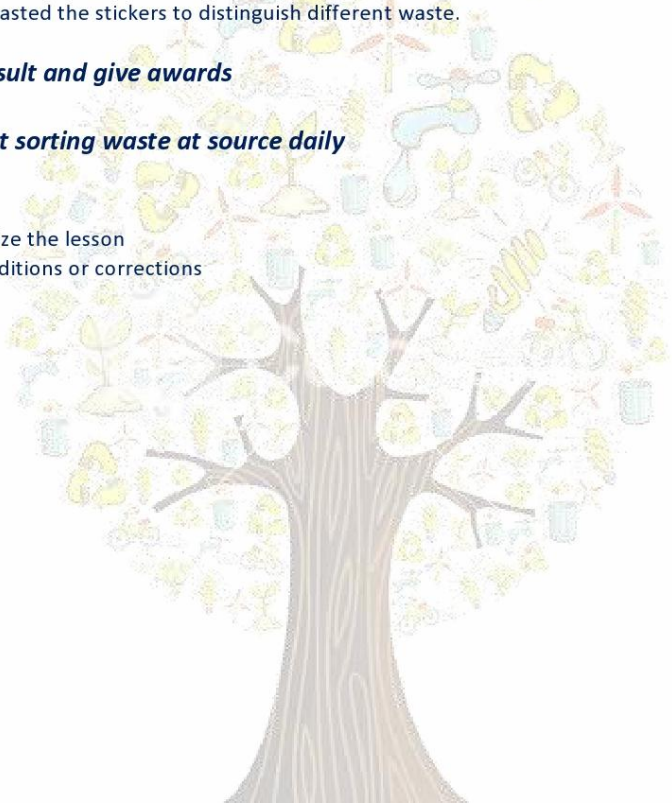
- Divide pupils into 2 teams
- Show them there are a bunch of products/ waste (can be toys; real products, real product packages or containers…)
- Pupils have 5-7 minutes to discuss in team which kind of waste group they belong to. Give them hint: they should point out which members in team will responsible for which categories (Pupils A, B are responsible for paper waste; pupils C, D are responsible for organic waste)
- After 3 preparation minutes, teacher will randomly call for a waste type (ex: organic waste), 1 pupil from each group has to run and pick one, which can be the trash, stuffs that will become that called type of trash (ex: leftover bread will become organic waste) and drop to the bin/ box they pasted the stickers to distinguish different waste.

Step 5: Check each team's result and give awards

Step 6: Guiding pupils to start sorting waste at source daily

Step 7: Lesson summary

- One or two pupils summarize the lesson
- Teacher makes the final additions or corrections



Attachment 2. Demo Flash Cards

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WasteED – Export of Education • WASTE MANAGEMENT

organic waste

Used for producing

biogas 

fertilizers 

food scraps 

fruit and vegetable skins and peels 

coffee grounds and filter papers 

tea leaves, tea bags

paper towers and napkins 

potting soil & plant parts 

metal waste

Used for producing

new metal objects

rinsed metal tins & cans

aluminum trays and foil

metal lids and bottle caps

used pots and pans

empty, depressurized aerosol cans

empty paint tins

small mechanical components

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glass waste

(glass packaging only)

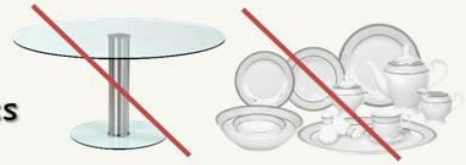
Used for producing

glass wool 

new packaging 

glass bottles and jars 

NO

glass or porcelain tableware, ceramics 

glass decorations 

glass mirrors 

glass windows 

glass windscreens 

paper waste

Used for producing

new print

newspapers

magazines

photocopy paper

envelopes

note paper

books
(without covers)

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Cardboard

(NOTE: Rinse clean of any food scraps and drains. Compress and stack)

Used for producing

paper roll cores

ice cream cartons

milk and juice cartons

cereal, biscuit and sweet boxes

disposal plates and wrappers

egg cartons and paper roll cores

Sugar and flour bags

Cardboard boxes

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Burnable/ Energy waste

Used for creating

heat

electricity

daily house waste, such as plastic bags and wrappers

dirty board, cardboard and paper

diapers and other hygiene products

cleaning items such as vacuum cleaner bags

worn-out clothes and shoes

CDs, videos and cassette tapes

food and plant waste

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Hazardous waste

disposaled in hazardous waste plants

paints, varnishes, glues, solvents

oils, oily waste, automotive fluids

chemicals with hazard symbol

batteries
(can also be returned to shops)

medicines, thermometers containing mercury
(can also be returned to pharmacies)

fireworks rockets
emergency rockets
and other explosives must be returned to the sellers

disposable gas bottles
(non-disposable gas bottles to be returned to the seller)

lanfill waste

(only non-recyclable waste not suitable for burning)

deposaled in landfill

glass and porcelain dishes, ceramics

mirrors, windows, glass shelves

incandescent light bulbs
(not fluorescent or energy-saving bulbs)

PVC plastics
(folders, plastics sleeves, inflatable toys)

mattresses, waster proof clothing

potting soil, ashes, cat litter

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Electrical & Electronic scrap

sent to manufactures for use of parts

refrigerators 

cooker 

stereos 

computer equipment 

TV

small electronic devices
(phones, shavers, electric mixers, etc…)

lamps 

fluorescent bulbs

energy-saving bulbs 

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large items

reused or
recycled or
used for energy production

large metal items

mattresses

furniture toilets and sinks

garden waste

used in landscaping

& for energy production

(Garden waste is too heavy for normal waste containers. Sand and damp garden waste are also harmful for incinerators)

tree branches

leaves and rakings