

WASTE MANAGEMENT TRAINING PROGRAM




Cross border partnership for
environmental protection and improving
life quality in the cross border area



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1. General information

This training programme (curriculum) has been drafted within the Project “Cross-border Partnership for Environmental Protection and Better Quality of Life”, financed by the IPA Programme for transboundary cooperation Bulgaria - Macedonia (2014-2020).

The aim of the non-formal learning program is to use for educational purposes in primary schools with the aim of educating and raising the awareness of students about the proper handling of waste. In addition to information on easier education, the program also includes practical activities, events, school markets aimed at reuse of waste and easier handling thereof. The training program is prepared in the form of a curriculum and information for each class is provided as an annex to the program. The training program has been drafted based upon previous research and analysis of curricula, activities and events related to the environment, waste management and it has been developed in wide consultation process which included school teachers who participated in the project.

The training program can be used during biology, chemistry, natural sciences and even English classes. If the curriculum is fully completed, this content can be used during school ecology sessions.

The aim is to facilitate education for better waste management and incorporate information in the primary school curriculum that will improve knowledge and raise awareness about waste management.

Approach and methodology

In the process of preparing the training program, the following methodology was used:

- Analysis of the current curricula in the Republic of Macedonia in subjects that cover the topics of waste handling, that is everything related to types of waste generated in the environment, waste selection, proper collection and successful waste management.
- Analysis of the habits and manner of waste management in the primary schools in the cross-border region, as well as issues related to the types of waste and waste selection.
- Proposals for efficient measures for education purposes tailored for elementary school pupils in the cross-border region and related to proper waste management alongside with the adverse effects of improper waste selection.
- Elaborating and summarizing good practices, analyzes and recommendations for complementing the programs for informal learning the topic of waste collection, management, selection and treatment.

Current state

In the last decade, within the primary schools in the cross-border region of the Republic of Macedonia and the Republic of Bulgaria, efforts have been made for proper waste management, that is, for proper selection thereof. There are numerous reasons for raising the awareness among students on this important goal. One of the reasons is the higher development component and the acquired habits among students as a result from their education in the field of waste management. Certainly here we

should mention the certain investments in the procurement of waste selection bins, which are already present in almost every school. If the acquired knowledge among students on environment protection is upgraded each year, it will contribute towards deepening their habits which will result in improved environmental conditions in their residing area. Based on the assessment of the current situation with the curricula and what is covered in the primary schools related to waste management, this training program has been developed.

2. Waste Management Training Programme (Syllabus)

2.1. 6th Grade

Objective	Proposed activities (Topic of lesson)	Resources	Pupil participation
What is waste	First school class 1. What is waste (general knowledge, definitions, types of waste) 2. How is waste generated?	First school class See lessons for 6 th grade	First school class 1. The pupils discuss the topic and its meaning. After that, define waste in accordance with the definitions given in the teacher handbook. 2. The pupils name different ways of generating waste. After that, name examples given in the teacher handbook.
	Second school class 1. Waste in our daily surroundings 2. How much waste do we generate?	Second school class See lessons for 6 th grade	Second school class 1. The pupils reflect on and discuss the contents of waste. What kind of things is landfilled daily? Take examples of the things landfilled while they are at school. 2. Divide the pupils in groups and have each group analyze how much waste is generated in different parts of their school. Distribute gloves and plastic bags and measure the generated waste in that particular part of school. Finally, collect the contents of each group and multiply by every working day of the school. To illustrate, compare this quantity with the quantity of food, clothing or other items.
	Third school class 1. Where does waste end up? 2. What is a landfill? How many landfills are we surrounded by?		
		Third school	Third school class

		class See lessons for 6 th grade	1. Ask the pupils whether they know where daily generated waste ends up. 2. Ask the pupils whether they know what a landfill looks like. If there is a landfill in your vicinity, visit it. Discuss with the pupils what happens to the animals which live there, with the soil and the air. Ask the pupils whether they would like to live in the area and play there.
Let's learn the hierarchy of waste	First school class 1. Defining the hierarchy of waste 2. How can waste generation be reduced? Second school class 1. Reuse and waste recycling, general 2. How can waste be reused? What is recycling? How can waste be recycled?	First school class See lessons for 6 th grade Second school class See lessons for 6 th grade	First school class 1. Start the class by reminding the pupils of the annual quantity of generated waste in your school. What can be done about this? Second school class 1. Discuss waste reuse. Define different ways of reuse. 2. Prepare a workshop for waste reuse (use glass-jars and bottles and plastic -plastic bottles). One group works on glass, the other one on plastic. Use glass to make decorations, candle holders and vases and make flowerpots from plastic bottles, in which you should plant flowers and other herbs.
How do we properly manage the waste which	First school class 1. Waste Management (Principles of proper waste management) - selection and proper disposal		First school class 1. Enter the classroom and throw out the contents of the dustbin. Ask the pupils whether they know what waste management is. Is waste management important? Why is it important?

we generate?	2. How to select properly?	<p>2. Practical work on waste management (selection and proper disposal). Take three bins (blue, green and yellow), old paper, empty glass and plastic bottles, glass jars and tins. Explain that the blue bin is for paper disposal, the green one for glass and the yellow one for plastic. Ask the pupils to dispose of the abovementioned items properly.</p> <p>* Conclude that people should dispose of their waste properly and not expect others to do so for them(demonstrates by properly disposing of the waste thrown out in the beginning of your class). It is very important to identify the types of waste and select waste properly. Why this is important will be dealt with in the 7th grade.</p>
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2.2. 7th Grade

Objective	Proposed activities (Topic of lesson)	Resources	Pupil participation
Let's learn other types of waste	First school class 1. How are other types of waste generated? 2. Other types of waste (batteries), what are they and how are they generated?	First school class See lessons for 7 th grade	First school class Let's revise the types of generated waste. After that, we discuss with our pupils whether or not the mobile phones, PCs, tablets, phone and car batteries can be categorized as waste. We conclude that, apart from the already mentioned types of waste, all of the abovementioned items are waste when we no longer need them. Exercise: In groups, do a quiz to assess knowledge of the different types of waste.
	Second school class The hierarchy of waste (reduction, reuse, recycling). Why is it important to practice the hierarchy of waste? How can E-waste and batteries be reduced and reused respectively?	Second school class See lessons for 7th grade	Second school class Divide the pupils in three groups. One group should write about E-waste reduction, the other one about reuse and the third group should write about the importance of E-waste recycling.
	Third school class Waste selection- Why is it important to select these types of waste?	Third school class See lessons for 7th grade	Third school class Take two containers. A red one and a plastic one with a lid. Explain that the red container is for E-waste and the plastic one is for batteries. State that these two types of waste cannot be mixed. During class, discuss the importance of proper selection.

The impact of E-waste and batteries on the environment	<p>First school class</p> <p>1. E-waste, the environment and the impact on human health</p> <p>Second school class</p> <p>1. Waste batteries, the environment and the impact on human health</p> <p>Third school class</p> <p>1. National and International Waste Management practices</p>	<p>First school class</p> <p>See lessons for 7th grade</p> <p>Second school class</p> <p>See lessons for 7th grade</p> <p>Third school class</p> <p>See lessons for 7th grade</p>	<p>First, Second and Third school class</p> <p>Watch the available video by clicking on the link below and discuss the E-waste treatment in other countries.</p> <p>https://www.youtube.com/watch?v=v1TaDwPUu4c</p>
Organising a school market	<p>First school class</p> <p>1. School market (rules, organization and objectives)</p>	<p>First school class</p> <p>See lessons for 7th grade</p>	<p>First school class</p> <p>Announce the upcoming market and discuss its organization. Point out examples and assign tasks to some pupils in order for them to coordinate the rest of the 7th graders.</p>

2.3. 8th Grade

Objective	Proposed activities (Topic of lesson)	Resources	Pupil participation
Let's revise the most common types of waste from our daily life	<p>First school class</p> <ol style="list-style-type: none"> 1. Which type of the previously mentioned waste do we encounter most frequently? 2. Other types of previously not mentioned waste (Medical, Hazardous Waste) <p>Second school class</p> <ol style="list-style-type: none"> 1. The adverse effects of waste on the environment and human health 	<p>First school class</p> <p>See lessons for 8th grade</p> <p>Second school class</p> <p>See lessons for 8th grade</p>	<p>First school class</p> <p>Let's revise the types of waste we generate. Secondly, discuss the waste we daily encounter. Activity: Prepare a list of items and ask the pupils to say which waste type they will belong to once their shelflife expires.</p> <p>Second school class</p> <p>Divide the pupils into three groups and assign a task to prepare presentations. The first group prepares a presentation for plastic waste and its adverse effects on the environment. The second group does so for waste paper and the third group repeats the same for waste glass. Have the presentations, comments and discussions during the following class.</p>

Economic aspects for proper waste management	First school class	First school class	First school class
	1. Positive consequences resulting from waste reduction, reuse and recycling	See lessons for 8th grade	Discuss the consequences of the economic aspect, as well as whether or not waste reuse and recycling can result in new jobs. In addition, discuss whether or not waste reuse and recycling can have an effect on the financial condition. <i>Activity:</i> If possible, visit a collective waste treatment facility or a recycling, waste storage and transport company. Ask for a short presentation. If possible, invite them to your classroom and discuss recycling together.
	Second school class	Second school class	Second school class
	1. Workshop for waste reuse	See lessons for 8th grade	Assign previous tasks and ask your pupils to bring from home empty plastic bottles, lids, plastic bags, glass bottles, jars and other used items. Brainstorm ideas (what can be made from these items? how can they be reused?) and organise a competition. Award the best three contestants with something symbolic.

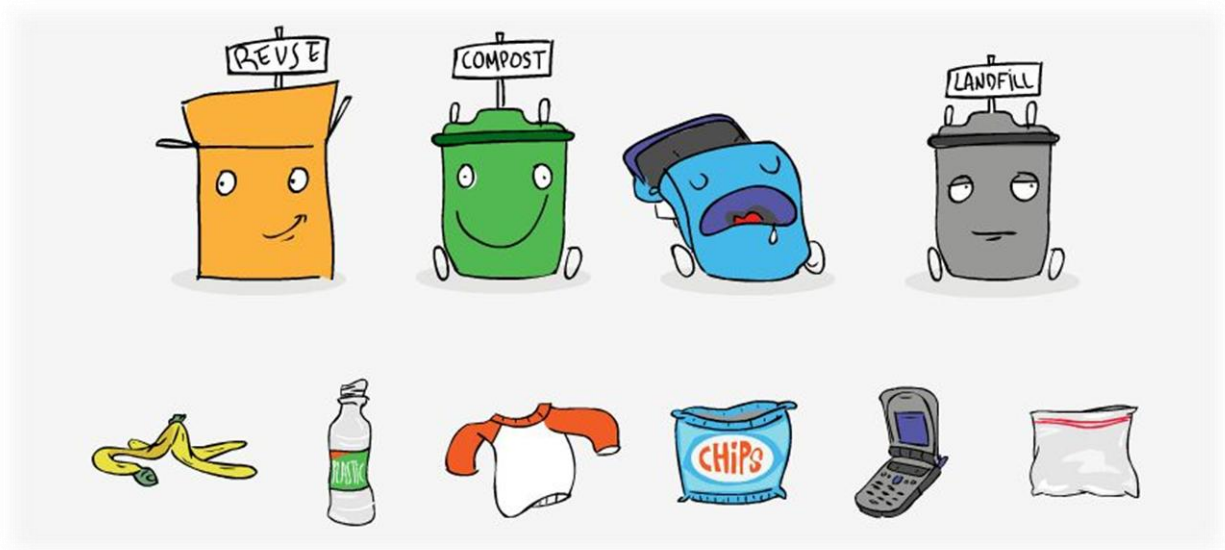
<p>What is Biodegradable Waste and why is it important to compost it</p>	<p>First school class</p> <p>1. What is Green Waste, what is Compost?</p>	<p>First school class</p> <p>See lessons for 8th grade</p>	<p>First school class</p> <p>Ask your pupils to think and discuss which everyday items will end up in a compost pile i.e. which everyday items can be composted.</p>
	<p>Second school class</p> <p>1. Make a compost pile at school</p> <p>2. Set maintenance rules</p>	<p>Second school class</p> <p>See lessons for 8th grade</p>	

2.4. 9th Grade

Objective	Proposed activities (Topic of lesson)	Resources	Pupil participation
Let's learn what hazardous waste is	First school class 1. What is Hazardous Waste	First school class See appendix lessons for 9 th grade	First school class Revise the types of waste we generate. After that, discuss with your pupils the type of waste we daily encounter. This is a lead-in discussion for the types of Hazardous Waste. Finally, ask your pupils to name the types of hazardous waste we daily encounter. <i>Activity:</i> Prepare a list of items and ask your pupils to categorize the waste as Hazardous and Non-Hazardous.
Waste and employment	First school class 1. Positive consequences resulting from waste reuse and recycling and creating new jobs	First school class See appendix lessons for 9 th grade	First school class Divide your pupils into groups and ask them to visualize their own waste management firms. The pupils should state what kind of waste they are managing and whether they are recycling, collecting or burning it. See the site of the Ministry of Environment and the operators in accordance with the legal regulations. http://www.moepp.gov.mk/?page_id=2699

<p>Having youth presentations</p>	<p>First school class</p> <ol style="list-style-type: none"> 1. An organization of presentations (directions, preparations and selection of target audience) 2. Presentations during the entire school year 	<p>First school class</p> <p>See appendix lessons for 9th grade</p>	<p>First school class</p> <p>Help your pupils during the organization of these presentations (during the selection of target audience, topics, classes and other preparations).</p>
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TEACHER HANDBOOK
for implementation
of the Waste Management Training Programme



6TH GRADE LESSONS

Objective: To learn what waste is

1. FIST CLASS, What is waste?

Garbage is one of the most visible signs of pollution. It's everything that remains where it should not be. Garbage is disgusting and dangerous. It may cause harm to people and the wildlife. It stimulates infestation by pests, such as rats, mice and gulls, and transmission of bacteria and diseases. The improper waste disposal is a serious offence and is sanctioned by law.

Waste is any matter or item that has been disposed of, or is intended to be disposed of, or is required to be disposed of by its generator or owner; in other words, waste is the name we give to anything that we throw away. Once the waste is collected from the dustbins, it is usually buried in large ground pits that go by the name of landfill.

Involvement of pupils: Before defining waste, discuss what the word waste may include. Ask them which items may constitute waste. Then ask them what our garbage contains? Tell the pupils that you will be discovering what sort of things we throw away daily and whatever becomes of them (e.g. from the different schoolrooms, the teachers' room, the kitchen). Ask the pupils if they know where the garbage goes once it is taken out from the schoolroom dustbins and into the garbage lorry. Most of the garbage ends up in a landfill, where it is simply thrown away; a portion of it may or may not decompose, but will either way have an adverse effect to the environment i.e. it will cause pollution.

How is it generated?

Although the planet Earth is abundant in living species, waste is generated only by one – the human. Waste is not only generated in households, it is also generated in factories, fields, everywhere around us. According to its composition, waste is generally categorized in 12 types, which, if separated, can be recycled and processed, whereas mixed together, these materials constitute a useless pile polluting the environment – regardless of whether the waste has been disposed of (landfilled) or burnt (in incinerators).

It is important to know that all waste is generated as a result of human activity and is perceived to be an inevitable by-product from the economic operations (waste generated in production, trade and unsustainable consumption of products). Waste generation indicates that matter and energy are being lost, and imposes costs to the society and the state for its proper management.

Solid waste is the waste generated in households or enterprises throughout the year. This waste is also called communal or municipal waste. Waste generation includes all the waste types that have been thrown away, regardless of whether or not, sooner or later, they have been landfilled or recycled. The

waste generation rate for households or enterprises is used to assess the impact of the municipal waste to its development.

Waste is a major environmental issue for many European states, ours included, considering the fact that the quantities of generated waste increase daily.

Municipal waste is expected to double by 2025. The higher the rate of urbanization, the larger the quantities of solid wastes generated. The highly developed countries generate half of the total worldwide waste, with Africa and South Asia producing much less.

The rate of generation of municipal waste depends on the economic development, level of industrialization, habits of the population and the local climate. In general, the grater the economic development and level of urbanization, the larger the quantity of the municipal waste generated. Income is closely related to urbanization, and the more the income and the living standard grow, the more goods and services are consumed, thus increasing the quantity of the waste generated. Residents of urban areas produce twice as much waste was the people in rural areas.

Involvement of pupils: Before continuing on the waste generation methods, ask the pupils to list the ways in which waste can be created. For example: at home: while we cook, while we eat, during celebrations and events; at school: while we eat, while we learn, while we rest during the small and big break, while we implement outdoor activities in nature, etc.

2. SECOND CLASS, The waste from our everyday life

The waste that is generated as a result of our everyday activities constitutes a municipal waste.

Municipal waste is the waste which is collected either by the municipality services or on their behalf. This includes the household waste, along with the bulk waste, a similar type of waste normally generated by commercial and trade activities, by administrative buildings, institutions and small businesses, the waste coming from our backyards and gardens, litter, the material collected from waste containers on the streets, as well as the waste from cleaning the green markets.

Involvement of pupils: Pupils think about and list items normally contained in the waste they generate. What type of things do we throw away on daily basis? Give an example of what is thrown away while they are at school. Draw a table and assign the students to record the items that they will throw away as waste in a period of one week. Once the assignment period is over, ask the pupils to count the items as per each waste type. Present the results during the next class.

How much waste do we generate?

According the National Statistical Institute of Republic Bulgaria an average od 419 kg waste per capita are generated at Bulgaria at 2015¹, wheather in Macedonia 376 kg per capita in 2016² which is almost similar quantity of waste generated in both countries.

¹ National Statistic Institute of Bulgaria

In the Republic of Macedonia, around 77% of the population is covered by the public municipal waste collection system, which is operated by public enterprises. The remaining portion of the population (23%) that does not use municipal services is predominantly concentrated in rural areas. It is a common practice to collect unseparated municipal and non-hazardous industrial waste, as well as unseparated non-hazardous and hazardous fractions of waste.

According to the State Statistical Office data, the total annual quantity of the collected municipal waste in the Republic of Macedonia in 2014 amounted to 569,794 tons. The quantity of generated municipal waste was 765,156 tons. The annual quantity of municipal waste generated per capita in 2014 was 370 kg or 1.01 kg per day. The largest quantity of municipal waste was collected in the Skopje Region, and the smallest quantity was collected in South-Eastern Region. The same is the proportion of the generated quantity of municipal waste.³

Involvement of pupils: Split into groups, let the pupils choose a section of the school building to investigate the amount of garbage that is thrown away on daily basis (e.g. in the different schoolrooms, in the teachers' room, in the kitchen etc.). Let each group measure the garbage collected in a single day, and let them add their amount to the table.

Then, let the pupils calculate the total amount of garbage thrown away every week, and then let them calculate how much waste is thrown away by the entire school over a period of one year.

3. THIRD CLASS, Where does our everyday waste end up? What is a landfill? How many landfills are there around us?

The generated waste is thrown out (disposed of) in adequate dustbins or containers, and is from there collected by public enterprises that are in charge of maintaining the public hygiene. The entire collected waste is transported to a landfill.

A landfill is a large area specifically constructed to accept the waste. Different types of landfills accept different types of waste. Household waste is typically taken to a local landfill. These landfills normally accept the waste that is composed of food leftovers, gardening residues, packaging materials, paper, car parts, textile, and construction waste. However, it is a much better option to reduce, reuse or recycle the waste, rather than to landfill it.

Landfills fill the area with stench; they attract insects, birds, mice and stray dogs and cats. Moreover, they can easily set on fire, thus imposing a direct threat to the nearby communities. Such landfills still exist in the Republic of Macedonia; they are merely dumpsites failing to meet the basic standards which are required to be classified as landfills.

Modern landfills are constructed following strict regulations, they must meet particular requirements that will make them safe for the people and for the environment. From all landfills in the Republic of Macedonia, only the "Drisla" landfill near Skopje meets the minimum criteria from the EU standards laid

² State Statistic Office of Macedonia

³ Environmental Statistics, 2015

down in the Landfill Directive. It is very important to point out that there are nearly 1,000 municipal dumpsites, especially in the rural areas, which are not covered by this table that presents the number of non-standard landfills in each region separately.

Region	Landfills	
	Number of landfills	Total surface area in thousand m ²
Republic of Macedonia – total	47	2077
Vardar	8	669
Eastern	11	266
South-Western	6	223
South-Eastern	7	420
Pelagonija	7	66
Polog	2	90
North-Eastern	4	270
Skopje	2	73

Source: State Statistical Office of the Republic of Macedonia

Landfills and the environment

Leachate or filtrate is the most hazardous by-product coming from the sanitary landfills of municipal waste. The waste material that is introduced to the watercourses together with the filtrate has a particularly adverse impact on the oxygen level, and consequently on all organisms living in there. The adverse effects arise from the intensive processes of biological degradation that consume large quantities of oxygen, which is otherwise required for sustaining the living organisms.

In order to reduce the risk from the adverse effects of the filtrate and landfill gas, it is recommended to evaluate in greater detail the engineering solutions that provide prevention against the uncontrolled leakage of the filtrate and landfill gas to adequate ecosystems, by additional installation of modern monitoring systems. In order to process the filtrate, it is necessary to build an adequate facility, and the cost-effectiveness of its utilization will mainly depend on the required levels of processing.

Many of the adverse effects may arise exactly from the landfilling operations. These effects may vary from:

- Fatal accidents (e.g. collectors buried under piles of waste);
- Infrastructural damages (e.g. deterioration of access roads under the weight of vehicles);
- Local environmental pollution (e.g. groundwater or surface water pollution by leakage and soil contamination during the use of the landfill and after its closure);
- Methane emanation generated from the degraded organic waste (methane is a greenhouse gas many times more powerful than the carbon dioxide and may prove hazardous to the residents of a given area);

- Infestation by disease carriers, such as rats and flies, especially from the improper landfill operations, which is frequently seen in Third World countries; Harm done to the wildlife; and
- General discomfort (e.g. dust, stench, pests, noise).

Noise and dust are generated in the environment by the vehicles arriving at the landfill site as well as by the operations carried out at the site. These adverse impacts are best addressed during the planning stage when it is possible to foresee which access routes to use and to propose the landfill geometry that can best mitigate the problems. Vector control is equally important, and its implementation can be relatively well controlled with the daily coverage protocols.

The main environmental risks associated with uncontrolled municipal landfills include:

- Groundwater contamination from rainfall leaching and draining under the landfill and downstream, (typically called “leachate”).
- Soil contamination from the infiltration of the leached rainfall.
- Surface water contamination from the direct discharge of water or contact / exchange with the contaminated groundwaters.
- Air contamination from the uncontrolled burning of the waste, as well as stench emanation.
- Greenhouse effect, resulting from the landfill gas highly concentrated in methane.

Major possible effects from the above listed risks include:

- Contaminated well water that is used for drinking, contaminated feed or irrigation water, all posing a threat to human health and the health of animals.
- Contaminated surface waters which harm the wildlife and limit the use of this water as a resource (as a drinking water).
- Contaminated air, threatening the human health and biological diversity.
- Bioaccumulation of toxic material in the food chain and in the natural flora and fauna.
- Degradation and devaluation of agricultural land and construction land (land loss).

The figure below illustrates the adverse effects from the landfill to the environment and human health.



Figure1: How does a landfill work?

Landfill is the site where waste materials are disposed of by way of burying, which is the oldest form of waste treatment. From a historic perspective, landfills have been the most frequent methods of organized waste disposal and are still used all over the world.

Typically, landfills containing non-hazardous waste apply the following techniques so as to meet the previously defined specifications:

1. Confinement within an as small area as possible,
2. Waste compaction so as to reduce its volume, and
3. Covering (usually daily) with layers of soil.



Figure 2: Dumpsite close the the town



Figure 3: Dumpsite outside the town



Figures 4: Dumpsite that is burning



Figure 5: Non formal waste collector

Education films that can be shown during the classes

1. <https://www.youtube.com/watch?v=wxj2nsJPXbM>
2. <https://www.youtube.com/watch?v=wugmX85ipRU>

A video on the Tetovo landfill

<https://www.facebook.com/groups/603965473124132/>
<https://www.youtube.com/watch?v=x-AaXy6FtFI>

Involvement of pupils: 1. Ask the pupils if they know where the waste that is generated daily ends up? 2. Do they know what a typical landfill looks like? If there is a dumpsite nearby, go out and have a walk to the dumpsite. Talk about the animals living there, what happens to them, what happens to the soil and the air. Ask them if they would want to live or play near a dumpsite?

Objective: To learn the waste hierarchy

1. FIRST CLASS, Waste hierarchy

In order to gain a proper understanding of waste treatment, we should first get to know the hierarchy of our waste, which, in fact, dictates the way in which the waste should be treated. Waste hierarchy ranks the waste management in accordance with what is deemed best for our environment. It gives the top priority to waste prevention, or, its minimization (reduction to the minimum). However, once the waste is generated, priority is given to its preparation for reuse, then for recycling, possibly also for use as fuel, and only as a final and the least desired solution for its landfilling.



Figure 6: Waste hierarchy

Waste management hierarchy should not be perceived as an objective which is either hard to achieve or quick to achieve, especially in consideration of the fact that various waste treatment methods exist that can have different impact on the environment. The purpose of the downward movement towards recycling and reuse is to make use of various waste management options before resorting to landfilling. The prevention of waste generation holds the initial position because waste reduction implies less collection and treatment, which is in direct correlation with costs and environmental impacts. Waste generation prevention means to use the materials, goods and services in a way that their production, utilization, reuse and recycle will result in the smallest possible waste production. Prevention is just a fraction of the overall concept of cleaner production that has been promoted by the United Nations Environment Programme for about fifteen years now.

Incineration, or waste burning and making use of the energy thus generated, is yet another option to avoid the landfills. Waste disposal at landfills is the lowest and the least desired option in the waste management hierarchy, however, it is still the most dominant method used in our country. Landfills in our country are in most cases mismanaged, and they fail to meet the minimum standards for environment and human health preservation. It is a huge challenge to reach certain standard with regard to landfill construction and to close down the landfills that are poorly managed and maintained. Exact and timely waste data are key elements for the long-term prevention of the illegal dumpsites. Inadequate data may lead to improper decisions regarding the legal regulations on waste and to installation of improper waste management infrastructure. Waste management is still a problem in our country, because the quantity of the generated waste is growing constantly, and the legal regulation is in certain cases poorly enforced.

2. Reducing the quantity of generated waste

To reduce the quantity of waste that is generated by our everyday activities, from the perspective of waste management hierarchy, includes prevention of waste generation and minimization of the generated quantities of waste.

Waste generation prevention or reduction implies reducing the use of resources, reducing the waste quantities, and reducing the hazardous characteristics of the generated waste.

In order to reduce the quantities of the generated waste, people's environmental awareness must be raised first. When making their purchases, people should carefully select their products, aiming to buy products that are not harmful to the environment, which are packaged in containers having the environmental mark impressed on them. People should strive to buy products packaged in reusable

containers or at least packages that the recycling of has been secured. For example, buying mineral water in reusable glass bottles, using one's own cloth bag for shopping instead of plastic bags, cooking at home and avoiding take-aways from restaurants, using recharging batteries, etc.

Involvement of pupils:

Start the class by reminding the pupils how much garbage is thrown away by your school annually, according to their own calculations. What can we do about it?

1. Reducing the quantities of the generated waste – How can we reduce the quantity of waste? For example:

- Selecting products in the smallest available packaging or which spend the least resources for their manufacture;
- Avoiding disposable (single-use) products and disposable materials;
- Buying of recycled products and recyclable products which can be used several times or are biodegradable;
- Reusing the food leftovers, instead of throwing them away.

2. Reach the conclusion that when we reduce, reuse or recycle our garbage, we will waste less, and thus we will help preserve the environment.

2. SECOND CLASS, Reuse and recycling of waste (products), general

The second priority, reuse of resources, maximizes the opportunities for using the waste again, or for its recycling, processing and energy generation.

Where waste prevention and reduction are not possible, the next most desirable option is to use the materials again without processing them further, so as to avoid the costs related to the use of energy and other resources required for the recycling. For example, many household and industry items can be repaired, reuse, sold or donated to charity.

Reuse (without further processing) and recycling (processing the waste materials so as to make the same or different products) preserve the economic value of the materials and contribute for environmental preservation through the reduced use of new materials and reduced generation of new waste.

Reuse of product means to use the products again for the same or for a different purpose. Reuse is an effects waste management method from the waste management hierarchy, which prevents the waste to enter the disposal system. This waste treatment method helps minimize the waste quantity, saves the natural resources and reduces the costs related to production and processing.

Moreover, reuse can be interpreted as the action or practice of using a particular item once again, be it for its primary purpose or for a new function (creative reuse). Reuse is distinct from recycling, which is the factory processing of the used items so as to render them into raw materials that can be used for the production of new products. The reuse of previously used items, without further processing, helps

save on time, money, energy and resources. Within broader economic frameworks, quality products can be made available to the people and organizations with a limited budget, thereby generating new jobs and businesses that will boost the economy.

Recycling is a waste treatment method the aim of which is to make raw materials that can be used for the production of the same or a different product.

Recycling is the process of converting the waste materials into new materials and items. This is an alternative to the “conventional” waste disposal, which can help save materials and reduce greenhouse gas emissions (compared to manufacture of plastics). Recycling may prevent the loss of potentially useful materials and reduce the consumption of raw materials, thus reducing as well: energy consumption, air pollution (from incineration) and water pollution (from landfilling).

2. How can we reuse the waste? What is recycling? How can we recycle the waste?

How to reuse more easily?

- Buy refillable products so as to avoid the packaging waste. Plan what you need, so as to avoid excessive and unnecessary purchases that would eventually be thrown away. Buy items that have long expiry dates and that can be used several times.
- Use washable cloths for cleaning, so as to avoid using paper towels and tissues.
- When you do the spring cleaning, donate all the clothing items and other products that you no longer use to charity, or even to your neighbours, who may find them useful.
- Use your water and electricity more efficiently. For example: switch off the bulbs, TV and computer whenever you don't use them. Don't let the water run from your tap when you don't use it.
- Make e-payments for your bills – this saves on paper and electricity.
- Donate your old newspapers and books to senior homes, schools and libraries.
- Use rechargeable batteries. Remember, batteries cannot be disposed of together with the municipal waste, so make sure you treat them properly. More information at www.elkolekt.mk for Macedonia and Ecobateri <http://www.ecobatterybg.com/?cid=39> for Bulgaria.

Involvement of pupils:

1. Talk about possibilities to reuse the waste. Define several methods of reuse.
2. Organize waste reuse workshops (use glass – jars and bottles, and plastic – bottles). One group can work with glass, the other with plastic (use the glass to make decorations, candle sticks, vases; turn the plastic bottles into pots where you will plant flowers and herbs).
3. Ask the pupils to make posters that will encourage the others to reduce, reuse and recycle their waste. Remind them that the poster must be convincing in order to be efficient. Put the posters out all around the school.

Objective: To learn how to manage properly the waste that we are generating

1. FIRST CLASS, Waste management (good waste management principles) – selection and proper disposal

Waste management comprises all the actions and activities that are necessary to handle the waste, from its generation to its final disposal. This includes, among other things: collection, transport, treatment and disposal of the waste as well as its monitoring and regulation.

The term ‘waste management’ typically refers to all waste types, regardless of whether they were generated when the raw materials were extracted, or when the raw materials were processed into semi-finished goods and final products, or when the final products were consumed, or in the course of implementation of other human activities, which may include municipal waste (from residential, institutional, or commercial buildings), agricultural waste and social waste (waste from healthcare, hazardous household waste, and wastewaters). Waste management has the objective to reduce the waste’s adverse effects on health, environment and landscape.

One of the most important issues in the proper waste management is to properly select the waste. This includes the selection of various waste types and their disposal in different containers for each type of waste. According to the existing legislation, paper should be disposed of in blue dustbins, glass in green, plastics in yellow, metal and the waste of electric and electronic equipment (WEEE) in red dustbins. These colours are defined by legally binding acts for both existing Member States of the European Union (EU) as well as for the candidate countries.

2. How to select properly?

In order to be able to make a proper selection of waste, we need to have an adequate site where different waste types could be disposed. It is very important to have easily accessible dustbins for different waste types and to know which waste type belongs where. It is important to know that the colours are defined by legally binding acts for both existing Member States of the European Union (EU) as well as for the candidate countries, and so **paper should be disposed of in blue dustbins**, **glass goes in green**, **plastic goes in yellow** and **metal and waste of electric and electronic equipment (WEEE) goes in red dustbins**, whereas waste batteries should be disposed of in special tubes which are used solely for waste batteries collection.



Figure 7: Waste bins for proper waste selection⁴

Waste types

The Law on Waste Management defines several types of waste, as follows:

1. Hazardous waste
2. Non-hazardous waste
3. Inert waste
4. Municipal waste
5. Commercial waste
6. Industrial non-hazardous waste
7. Biodegradable waste
8. Waste oils
9. Batteries and accumulators
10. Used batteries and accumulators
11. Waste electric and electronic equipment
12. Waste packaging

The 6th grade will only look into the waste types generate by our everyday activities, that is, waste types that could be recycled by proper selection. These waste types include:

- Packaging waste (glass, plastics, paper)
- Waste electric and electronic equipment
- Used batteries and accumulators
- Biodegradable waste
- Municipal waste

Definition of these waste types:

⁴ Such bins are granted to 12 primary schools from Southeast planning region, which participate to the project WasteEDU

WASTE TYPE	DEFINITION
Municipal waste	Municipal waste is the waste generated by physical persons in households (household waste) and commercial waste. Household waste is the waste that is collected every day from the households, as well as the separately collected hazardous waste from the households, bulk waste, garden waste etc.
Biodegradable waste	is any waste that can be degraded through anaerobic (without oxygen) and aerobic (with oxygen) processes, such as food leftovers, garden refuse, paper and cardboard.
Used batteries and accumulators	are the batteries and accumulators that can no longer be used and should be processed or disposed.
Waste electric and electronic equipment	is any electric or electronic device that has been, will be or is required to be disposed of by the owner, including all their parts and components that are an integral part of the device at the time of disposal.
Waste packaging	is any packaging or packaging material that has been disposed of, will be disposed of or is required to be disposed of by their maker or owner, except production residues.

Involvement of pupils:

1. Enter the classroom, throw out the content of the dustbin and scatter it all over the place. Ask the pupils if they know what waste management is? Is it important how we manage our waste? Why is it important?

2. Waste management exercise (selection and proper disposal)

Take three bins (blue, green and yellow), and take some old paper, old plastic and glass bottles, glass jars, cans.

Explain that the paper should be disposed of in the blue bin, glass in the green, and yellow if for the plastic. Then ask them to dispose of some of the items they have with them.

Reach the conclusion that people should on their own clean up their garbage, not wait for the others to do it for the (the teacher will give a personal example of this, by picking up the scattered garbage and throwing it into the dustbin). It is also very important to distinguish between different types of waste and to properly select them. Why is it important will be taught in the seventh grade.

3. Organize a waste selection competition in each class.

At the beginning of the school year inform the classes that you will launch a waste packaging collection competition (for glass, plastics, paper). In the meantime, talk to a collective waste treatment facility or a collection centre to grant a small award to the class that will collect the largest quantity of waste. You can award 3 prizes, for the class that will collect the largest quantity of plastics, the largest quantity of glass and the largest quantity of paper. These prizes may not be a great expense for the company (an excursion to the nearest mountain, lake), purchase of a computer, printer, etc., but the collected waste will have a great economic value and will help preserve the environment.

7TH GRADE LESSONS

Objective: To learn the other types of waste

1. FIRST CLASS, Other types of waste, how are they generated?

Hazardous waste is the waste that contains substances that have one or more of the following qualities: explosiveness, reactivity, inflammability, irritability, toxicity, infectivity, carcinogenicity, etc. Because of the hazardous substances contained in the hazardous waste, it poses a serious risk to the environment and human health, if not properly and safely managed. Certain economic sector produce hazardous waste, largest of which the processing industry. Similar to other types of waste, the key elements of the safe management of hazardous waste are the introduction of a proper legal regulations, adequate training of the staff handling the waste, and public awareness raising.

The major quantities of hazardous waste (around 75,500 t/year) are produced by the industry and are disposed of at the industrial landfills. The smaller-scale hazardous waste generators produce around 2,000 t/year hazardous waste, out of which 1,300 t are sold/recycled, and the remaining waste is in the perimeter of the installation, or mixed with the municipal waste. There are no officially authorized collectors and transporters of hazardous waste. It is also assumed that certain generators and their waste are not covered by these reports, and the quantity of hazardous waste they produce is estimated to around 500 t/year. The local deposits of hazardous waste are environmental hotspots because of their impact on the environment.

Hazardous waste poses a greater risk for the environment and human health than the non-hazardous waste, which is why a strictly controlled regime is required for its management.

Following waste types constitute the group of hazardous waste:

- Medical waste,
- Waste oils,
- Waste batteries and accumulators (WBA), and
- Waste electric and electronic equipment (WEEE).

In the seventh grade we will focus more on WEEE and WBA, because these are the waste types that we encounter every day.

What is e-waste (WEEE)? E-waste (or WEEE – waste electric and electronic equipment) is a general term used to describe an old, outdated or rejected electronics that contains electrical parts. This includes all items ranging from household appliances, such as refrigerators and toasters; to IT equipment, such as laptops and smartphones; consumer electronics, such as TV sets and MP3 players; to tools, such as electric drills and lawn mowers; and many more.

E-waste is an entirely different waste type, compared to the classical municipal waste. It a complex mix of hazardous and non-hazardous waste, containing also recoverable substances of economic value. However, e-waste recycling may not bring profit, mainly because of the complexities of the recovery

process for particular substances from the complex products. Therefore, the traditional waste management policies cannot be easily applied to e-waste. E-waste requires segregation, collection, transport, treatment and disposal, in order to avoid the release of harmful substances and allow for an efficient recovery of valuable raw materials.

In 2014, 41.8 million tons of e-waste was generated worldwide. This waste quantity would suffice to load 1.15 million large trucks. If we arrange all these trucks one after another, the line would stretch from New York to Tokyo and back.

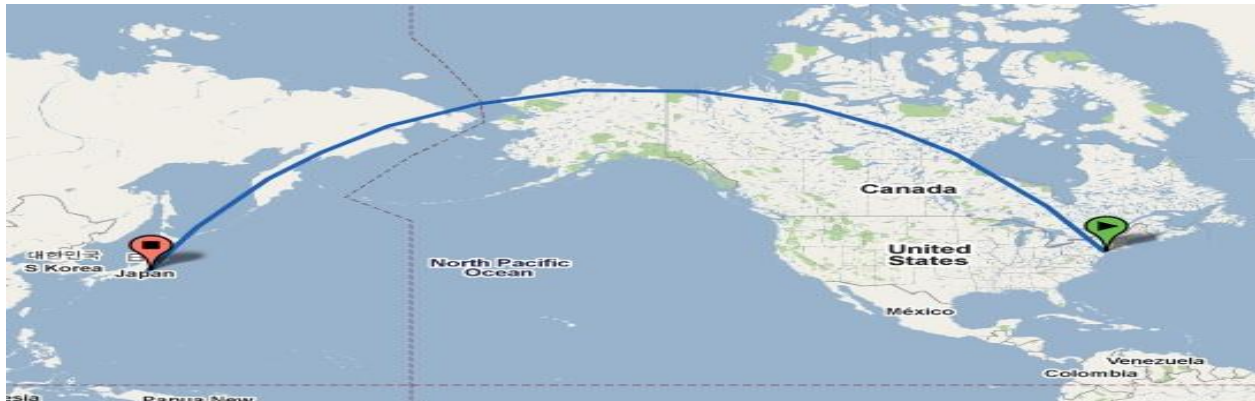


Figure 8: Illustrating the distance between Tokio and Newyork

Or, this is equal to throwing away 800 laptops every second!

Example of devices that belong to the groups of electric and electronic waste:

ELECTRONIC WASTE	ELECTRIC WASTE
<ul style="list-style-type: none"> • Desktop and laptop computers • Keyboards, mice, cables, speakers, earphones • Landline phones and mobile phones • MP3 players • Digital cameras and video cameras • Printers, scanners and fax machines • Stereo system 	<ul style="list-style-type: none"> • Ovens • Washing machines and dishwashers • Heaters • Microwave ovens • Bread maker, coffee machine, and other home appliances • Air-conditioners

2. Other waste types (batteries), what is generated and how?

Batteries and accumulators play an important role in making sure that many of the home products and home appliances operate properly, thus constituting a vital energy source in our society. Every year around 800,000 tons of car batteries, 190,000 tons of industrial batteries and 160,000 of ordinary batteries enter the EU.

Millions of batteries are used and thrown away on daily basis. Batteries provide us with energy anywhere we need it, regardless of the distribution grid. The technological development and the growth in production of high-tech products have increased the need for batteries. The increased number of batteries is also increasing the responsibility we have for the huge quantity of spent batteries. A battery is an electrochemical device that stores chemical energy, in the form of potential energy, which then converts to electric energy when battery's ends, the electrodes, get connected to a conductor. Batteries allow us to be independent from the electric grid, and they are a necessity in our everyday life. Due to the fact that they contain toxic chemical elements, such as heavy metals, they have been classified in the category of hazardous waste. The basic division of batteries is the one in portable and car batteries.

Portable batteries can be further divided into:

- Primary, or disposable batteries, and
- Secondary, or rechargeable batteries.

For the purposes of their chemical composition, primary batteries (alkaline, zinc air, silver oxide, and button cell), under the national regulation, may contain up to 25 milligrams of mercury. m Secondary batteries contain lead and cadmium.

Involvement of pupils:

Let us remind ourselves what types of waste we know. Then, let's talk to the pupils whether our mobile phones, computers, tablets, phone batteries, and accumulators can become a waste. Reach a conclusion that, in addition to all waste types we were familiar with so far, the items listed above will also become a waste once that we stop using them.

Exercise: Split the pupils in groups and give them an assignment to devise a quiz and verify the knowledge of the waste types they had learned so far.

2. SECOND CLASS, Waste hierarchy (reduction, reuse, recycling). Why is it important to practice the waste hierarchy? How can we reduce and how can we reuse the e-waste?

Electronics has special characteristics because its production and consumption are the source of major environmental consequences, making it a problematic and hazardous waste, but also an opportunity for profit. The worldwide quantities of e-waste grow rapidly, and this growing trend is expected to continue at undiminished pace for a long period of time, due to the invention of new technologies and pocket electronics. A combination of the ever-faster invention of new products and the limited subsidies for concept designs that would allow for their repair and upgrading makes our devices become outdated quickly and thus be rejected.

This is what you can do to contribute to the e-waste reduction:

- 1. Buy less.** Don't substitute your old device, if it's still operational, just because a new model came out on the market. If you still decide to buy a new device, make sure it is labelled as environmental-friendly.
- 2. Donate.** Old devices that you no longer use could be donated. There are many people who would gladly accept them and continue to use them. If you have an equipment to donate, you can advertise it on our website, in the "Reuse" section.
- 3. Return it back to the producer or recycle.** Many producers provide the opportunity for you to return your old device, in order for them to be able to properly recycle it. There are also companies in Macedonia that take over e-waste and recycle it, but for this to happen, you should be able to offer larger quantities of e-waste. If you have e-waste that you wish to dispose of, let us know so that we can provide further guidance.

Involvement of pupils:

Split the pupils in 3 groups. Let one group write about the options for e-waste reduction; let the second group write about e-waste reuse; and let the third group write about the importance of e-waste recycling.

3. THIRD CLASS, Selection of waste – why is it necessary to select these types of waste?

The poor e-waste management means that communities and the environment will continue to pay the price of the toxic and inefficient design by electronics producers. For example, a large share ends up in the landfills where hazardous substances may leach, mercury may evaporate, and fires can set off, all of which leads to atmospheric pollution and generation of toxic dust residues. Moreover, there are illicit e-waste flows from the rich countries to the developing countries. The full absence of or the poor enforcement of the legal regulations on environmental protection and workplace safety allow the unscrupulous waste traders to use the cheaper labour force costs in the developing countries, thereby maximizing their profit from recovery of substances.

Electronic and electric devices contain many toxic substances, which makes the e-waste toxic. More than 1,000 materials are used to manufacture our electronic gadgets and their components – chip conductors, motherboards, hard disks etc. Many of these are toxic, including PVC, heavy metals (such as lead, mercury, arsenic and cadmium), hexavalent chromium, plastics and gasses, which can all be harmful to the human health and the environment unless managed properly. Bromine fireproof materials, heavy metals (such as: lead, mercury, arsenic) and many more substances found in e-waste may seriously harm the human health and the environment, unless managed properly. Landfills are the site where majority of e-waste ends up, and even the most modern among landfills cannot succeed in preventing the heavy metals and other toxic substances from leaching into the soil and waters.

Moreover, electronics typically contains valuable and more and more rare substances. A single computer would normally contain iron, aluminum, copper, lead, nickel, tin, gold, silver, platinum and

palladium. This is why e-waste recycling could be a potential source of income. The recovery of precious metals and other substances from electronics could also reduce the need to mine for new raw materials. In order to be able to properly handle the e-waste and to protect ourselves from its adverse effects, first, it is necessary to properly select it, and then to properly dispose of it. WEEE must not end up mixed together with the municipal or other types of waste. With the proper selection of this waste type we contribute for its proper treatment and for the reduction of its impact on the environment.

Involvement of pupils:

Take a red container and a plastic container with a lid. Explain to the pupils that the red container is intended for e-waste, and the plastic one for batteries. Make a point that these 2 waste types must not be mixed. Then, during the class, speak about the importance of the proper selection.

Objective: To learn the impact of e-waste on the environment

1. FIRST CLASS, E-waste and its impact on the environment and human health

Electronics contain many toxic substances, making the e-waste itself toxic. The complex composition of electronics includes an amazing number of materials, some of which are hazardous and hard to handle when they become waste.

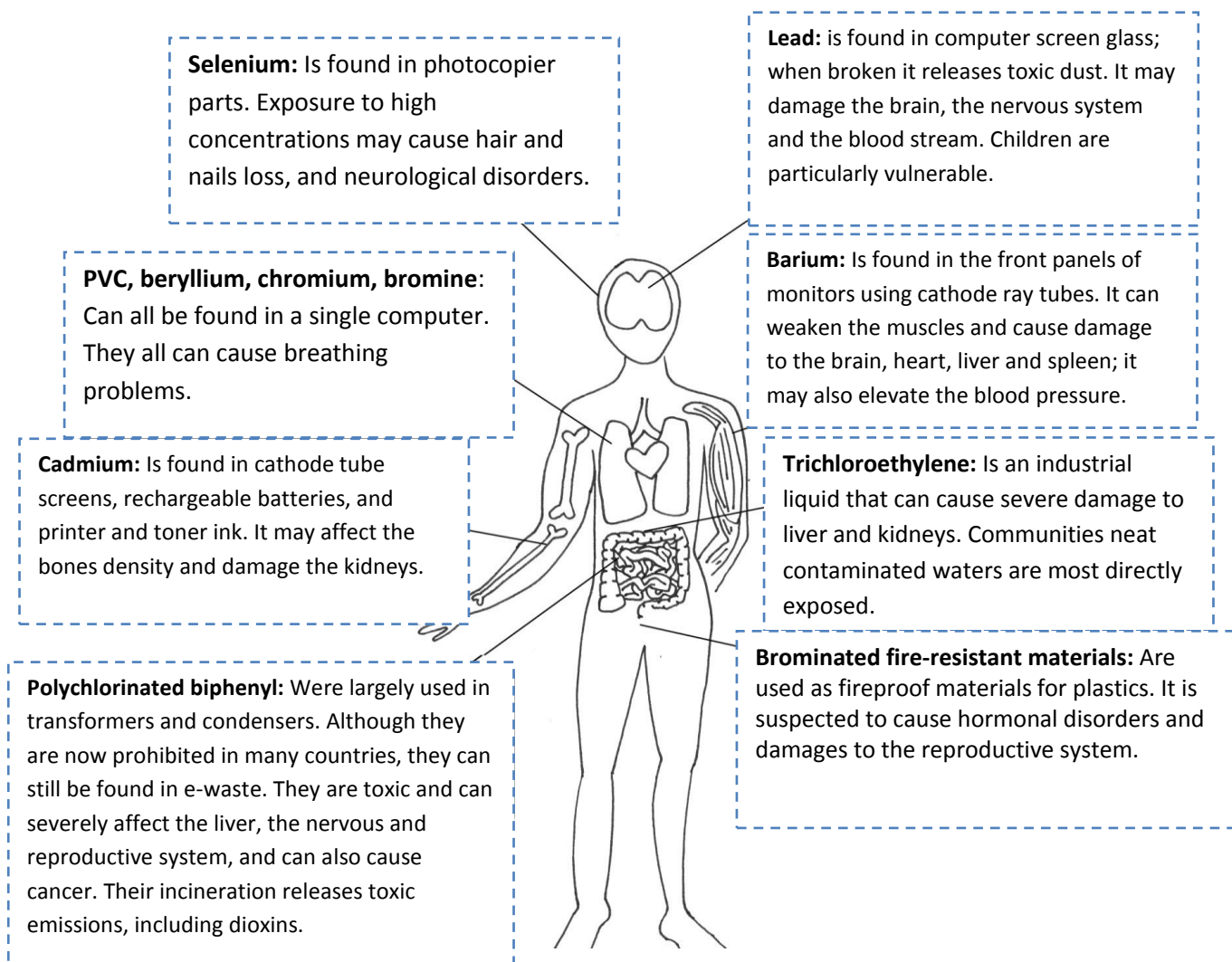
Majority of old-timer refrigerators and deep freezers, which could be found on the market until 10-15 years ago, contain **FREONS**, an ingredient that has the power to deplete the ozone layer and thus contribute to the global warming i.t. to climate change.

Ammonia is also found in refrigerators and deep freezers, and in addition to being able to start fires and explosions, this compound is also a potential hazard for the environment and the human health.

Mercury is used in fluorescent bulbs, medical equipment, data transmission systems, telecommunication and mobile phones, and can be particularly harmful to pregnant women and young children.

Due to the adverse effects of **asbestos**, its application in contemporary home appliances is prohibited. However, home appliances manufactured 20 or so years ago, such as coffee machines, toasters and irons, some electric heaters and other items where heat insulation was required are likely to have asbestos, so it is necessary to treat them properly and handle them with care during the disposal of this waste type.

If they are not treated properly, all these hazardous materials may end up in nature, or even in our homes! Also, it is important to know that hazardous substances may leak or evaporate from damaged WEEE, and in contact with skin, eyes or other parts of the body, they may cause irritation. This image below shows the adverse effects to the human body of all these e-waste components.



Source: Silicon Valley Toxics Coalition, 2010

2. SECOND CLASS, Waste batteries and their impact on the environment and human health

When we throw away the batteries together with the municipal waste, they end up in landfills, where the heavy metals they contain leach into the soil and groundwater. The contaminated soil and water affect the quality of animal nutrition, and consequently the food products coming from the soil, such as milk, cheese etc. receive higher levels of heavy metals. The increased quantity of heavy metals in the human organism may cause headache, abdominal pain, epileptic seizures, deformations of the bone system, osteoporosis, sterility, cancer, coma, and even death. In many cases this waste is burnt at the landfill or in special furnaces (incinerators); and when metals are burnt, they concentrate in the ashes that is created during the burning, or are introduced in the air through the gasses released from the

chimneys. Because of the hazard they pose, batteries and accumulators are regulated by law which aims to establish a sustainable management system for batteries and accumulators and for waste batteries and accumulators. The recycling of metals contained in batteries contributes to energy savings from 45% to 90%, compared to the production process starting from ore processing. The benefits are twofold: saving of energy and saving of raw materials.

It takes large amounts of energy to produce a single battery, and this energy is invested throughout the process, from its production to its sale. The production process begins in a mine, with the extraction of heavy metals from the ground, then the ore is transported, crushed and processed, then follows the transport to battery factories, involvement of raw material markets, and ends with the wholesale and retail, all the way to the end users – the industry or the people. In addition to energy savings, the resources which are obtained from the recycling of batteries are hugely important. The recycling of batteries yields metals (zinc, lead), sodium sulfate (from detergents), polypropylene etc. The recycling of batteries preserves the environment and the human health, saves energy and resources, reduces the costs and renews the resources that are needed in various branches of industry.

3. THIRD CLASS, National and International waste management practices

E-waste management in Europe: Producer responsibility organizations

All e-waste system established in the EU Member States, as well as in some countries outside the EU, are based on the principle of an increased producer responsibility. This principle requires that the electronics producers take the necessary financial and/or physical responsibility for their goods throughout the product's entire lifecycle, including when the products becomes a waste. In many cases, producer responsibility organizations have been established to help the producers meet these requirements. These are typically external organizations, non-profit bodies, who jointly negotiate the e-waste collection and treatment on behalf of their members. They also provide other services, such as drawing up reports, and distribution of fees. Some countries, such as the Netherlands, Sweden, Switzerland, Belgium and Norway, have single structures on the national level which do not compete with one another when enforcing the law that regulates the electronics producers of particular product categories. Other countries, notably Germany, France and Great Britain, run a number of structures which compete with one another so as to offer the best prices to their members. There are pros and cons for each of these solutions. For example, having single structures is a simpler solution and it endorses the economies of scale, transferring the competition between the collection and recycling agreements, and not between the structures themselves, which may result in law enforcement at the lowest possible costs, rather than in best environmental solutions. If there are several functional structures, coordination mechanisms would be of key importance, so as to provide equal opportunities and to avoid the selective collection of WEEE, e.g., to only collect waste items with a preferred weight, or from a preferred geographic area. If there is a single structure, transparency of allocation of treatment agreements would be of crucial significance (to avoid a possible, e.g., recycling monopoly).

Involvement of pupils: Watch the video available at the following link and talk about e-waste treatment in other countries. <https://www.youtube.com/watch?v=v1TaDwPUu4c>

You may also want to see the following videos:

<https://www.youtube.com/watch?v=HQZjouMTH08>

<https://www.youtube.com/watch?v=n6FJJ29k8uc>

<https://www.youtube.com/watch?v=2A4mzZ428Ag>

<https://www.youtube.com/watch?v=OJtn5VOk1xl>

<https://www.youtube.com/watch?v=zmZnEd0Lzuc>

<https://www.youtube.com/watch?v=d5oi4QOeQ3I>

<https://www.youtube.com/watch?v=tPASEem1t3E>

<https://www.youtube.com/watch?v=4JDGFNoY-rQ>

<https://www.youtube.com/watch?v=MNt6Pn7f6XI>

https://www.youtube.com/watch?v=h_ZqSige34c

<https://www.youtube.com/watch?v=g80oYUroAcU>

Objective: To organize a school market

1. FIRST CLASS, School market (rules, organization and goal)

Instructions how to prepare the market: Announce the market and talk to the pupils how to organize it. Give examples and assign tasks to some of the pupils, so that they can coordinate other classes. During the market you can organize resale of items made from the waste, and donate the proceedings.

8TH GRADE LESSONS

Objective: To remind ourselves of the most common everyday waste types

1. FIRST CLASS, Which of the waste types we have studies so far are most common

The ever-growing quantities of waste, the pressure it exerts on the environment, and the irreversible loss of valuable resources and energy during waste landfilling or incineration, whether done properly or not, impose the need to introduce sustainable ways for its management. The sustainable waste management methods teach us that items we no longer use, even the ones that have lost their purpose value, are not merely a piece of garbage that we should rid of forever. All of them hid valuable resources that can be used again. In this way, it is not only that we don't burden our surrounding with our waste, but we also prevent the fast exploitation of the limited quantities of natural resources and we close the

natural cycle of matter and energy, which had been long disrupted by humans. In order to study the recycling opportunities and the proper waste treatment methods, in this class we will discuss the types of waste that we commonly encounter in our everyday lives.

Paper

Paper is made of cellulose fibres which are mainly extracted from wood, but can also be obtained from grass, reed, sugar reed, cotton or – from old paper. Trees are the most frequent resource used for extraction of cellulose fibres. When these fibres are soaked in water, they yield the pulp, which is then processed into paper.

For a paper to be considered recycle, the pulp may not contain more than 25% cellulose fibres obtained from trees or other plants. Paper cannot be recycled unlimitedly. During the recycled paper production process, a certain quantity of primary pulp must be introduced (pulp originating from a plant), so that the cellulose fibres can preserve their firmness and quality. Recycled paper usually has slightly shorter fibres than the primary paper, and may appear murkier than the primary one, but with additional treatments, the quality of more and more varied types of recycled paper does not differ at all from the quality of the paper received from tree pulp.

Tips on waste paper:

- Try not to use paper in large quantities!
- Use both sides of the sheet of paper. Instead of throwing it away in the dustbin, use the remaining clean margins of paper for taking notes or messages.
- Buy products from recycle paper whenever possible. This way you close the cycle and you make sure the recycling process continues.
- Reuse the enveloped - place a new stamp over the old one.
- Information, bulletins, documents can be sent electronically.

Does recycling of paper truly help our environment?

Even though the raw materials used for paper production usually comes from trees, it is wrong to assume that paper recycling contributes to saving our forests. Almost all of paper is made from wood obtained from the so-called "sustainable" forests. In these forests, trees are raised as a perennial crop, and once they are cut, they are replaced with new trees. Much more serious are the following problems related to paper production:

- ✓ Forest types and locations. As the need for paper grows, so grows the number of specific trees required for this purpose. This means that valuable wildlife habitats and ecosystems are being lost, because the old forests are becoming replaced with tree plantation intended for paper production. This is why paper recycling contributes for the preservation of wildlife habitats and helps prevent extermination of species;
- ✓ Mineral fertilizers, herbicides, insecticides, and other pesticides are frequently used in these "sustainable" forests so as to get a "healthy" crop. All this is damaging to the environment;
- ✓ There are limits as to how much we can go converting the natural forests into "farmed" forests. Felling of forests to the point of clearing the ground leads to soil erosion;
- ✓ The use of old paper to produce a new one, the issue of landfilling is also reduced;
- ✓ The recycled paper production uses 28-70% less energy and 35% less water.

Recycled paper production reduces the release of toxic matters into atmosphere (by 70%) and waters. Recycled paper is typically unbleached, but even if it were, the process requires 8% hydrogen peroxide, instead of chlorine. This method prevents the generation of dioxins, which are produced when bleaching is done with chlorine.

Which are the main types of paper that are used every day, and which cannot be recycled?

- Printing paper,
- White office paper,
- Newspapers, magazines,
- cardboard
- Mixed or colourful paper.

Non-biodegradable waste

Large quantities of major types of waste that are produced in large quantities every day cannot be degraded in nature, so they belong to the group of non-biodegradable waste. Non-biodegradable components of the municipal waste include: plastic, glass, and metals. They remain in the landfills for an unlimited period of time, causing larger or smaller adverse effects to the environment.

1 Plastic

The worldwide consumption of plastic today approaches 100 million tons a year, in contrast to 1950, when it was around 5 million tons a year. Today, plastic is mostly used as containers. Other areas where plastic is found include: civil engineering, electric and electronic industry, transport industry and furniture industry. In smaller quantities, plastic is used for: agriculture and horticulture, toy industry and sports gear industry, medicine, mechanical industry, and footwear industry. The annual plastic consumption in Western Europe increases by 4% on average.

Types of plastic:

There are around 50 types and several hundreds sub-types of plastic. Theoretically, all types of plastic can be recycled. We use various types of plastic on daily basis. In order to be recycled, plastics must be sorted according to their type, because every type has a different melting point and different characteristics. Plastic industry has developed identification codes for marking the different types of plastic. According to this identification system, plastic is classified in seven different types marked by numerical code, which is usually found on the bottom of the vessel.

Below you can find the coding system for the seven types of plastic.

- Type 1: Polyethylene terephthalate (PET). Common use: water bottles, soft drinks bottles, oil bottles, detergent bottles. This is the most frequently recycled form of plastic.
- Type 2: High-density polyethylene (HDPE). Common use: detergent bottles, milk bottles, plastic bags.
- Type 3: Polyvinyl chloride (PVC). Common use: plastic pipes, outdoor furniture, vacuumed packaging, liquid detergent bottles, outer layer of cables, PVC flooring, window frames.
- Type 4: Low-density polyethylene (LDPE). Common use: plastic shopping bags, food preservation containers.
- Type 5: Polypropylene (PP). Common use: bottle caps, drinking straws. Recycle centres almost never accept these type of plastic.
- Type 6: Polystyrene (PS). Common use: styrofoam, cups, plastic cutlery.
- Type 7: Other types of plastics. Common use: certain dishes for food. This type of plastic is any type of plastic that does not belong to types 1 to 6. Recycling centres cannot recycle this type of plastic.

The good side of plastic

The increased use of plastic is owing to its good characteristics:

- Possibility to be used for variety of purposes, and to be shaped for most specific technical requirements;
- It is lighter than other materials, making the plastic items much lighter, too;
- Long durability;

- Resistance to chemicals, water and other influences;
- The food that has been packaged in plastic containers preserves its hygienic and safety properties;
- It has excellent thermal and electric insulation properties.

Tips on waste plastic treatment

- Choose products that have been packaged in the minimum container, or in containers that can be recycled or returned. Recycled plastic can be used to make combs or nail brushes.
- Try to reduce the need for throwing plastics away. For example, when shopping, bring a cloth bag from home, or take the plastic bag from your previous shopping. Don't accept plastic bags, unless really necessary. If not possible to reuse, plastic bags should be recycled.
- Instead of throwing away the plastic toys you no longer use, give them as present to someone else.
- The can assign a new purpose to the used plastic containers and plastic bags. For example, use the yogurt bags to sprout new seedlings.
- Buy products whose container can be refilled later on производ.
- If there is no established model for plastic collection and recycling, make a proposal to the local authorities to establish one.

One tone of plastic yields 20,000 2-litre bottles or 120,000 plastic bags.

Glass

Glass production requires significant quantity of both energy and raw materials. The production of one ton of glass requires the use of 16 million kilojoules energy. It corresponds to 17,818.7 kilojoules of energy for 1 kilogram of glass. Further on, the production of one ton of glass generates 174.6 kilograms of waste from the excavation process and 12.7 kilograms of pollutants that are released in the air. As is the case with other materials, glass production and use have certain adverse effects on the environment. If we make a comparison between the advantages and disadvantages of using glass and other materials, it is worthwhile saying that glass can be continuously recycled into new glass containers.

Reuse of glass containers

Returning the glass bottles back to the retailers and collecting the deposit was, and in some cases is still a common practice. In addition to their relative weights, which is a necessary feature if they are to sustain years of use and cleaning, returning the glass bottles back to the shops is still the best option available. Moreover, bottles and jars can be reused for storing and packing homemade food.

Recycling of glass containers

Glass recycling process, which is the production of new glass from broken glass, is saving on energy and is reducing the quantity of waste and pollutants generated during the production process. By adding the broken glass to the raw materials used in glass production, we reduce their melting point, which consequently leads to energy saving. For every ten percent of broken glass added to the furnace, the required temperature is reducing by ten degrees. New glass can be produced from a mixture containing more than 83% broken glass, meaning that large quantity of energy can be saved. By using 50% recycle glass in the production process, the use of water is reduced by 50%, the waste which is generated during the excavation of the raw materials necessary for the glass production is reduced by 79%, and the gas emissions are reduced by 14%. By using 1 ton of broken glass we save 1.2 tons of raw materials, which would otherwise be used in the production process, at the same time reducing the waste generated during their excavation, as well as other by-products that are created during the glass production process. Glass recycling also saves on landfilling space, which becomes increasingly expensive. Instead of turning it into waste and degrading it into landfills over an indefinite period of time, glass containers can be recycled unlimited number of time, as its structure is not destroyed when the glass is reprocessed. The colour of the broken glass should correspond to the colour of the new glass that is being produced. Therefore, before crushing it into broken glass, glass containers must be separated according to colour (colourless, brown and green). During the process of collecting and delivering the glass containers, some glass bottles get crushed into tiny pieces. They are too small to be sorted by hand, so a “mixed” type of broken glass is formed, containing all the three colours. Glass container producers cannot make use of the mixed broken glass, they only buy the broken glass of a uniform colour. Therefore, the mixed broken glass is provided with an altogether new purposes. One of these is the use of the mixed broken glass as an aggregate for road construction. It can also be used for production of asphalt, which gives the so-called “glassphalt”. We can easily discern whether the asphalt or the concrete contain broken glass, as the reflected light from pieces of glass make their surface shiny. Secondary glass can also be used to make the glass wool for insulation purposes.

Tips on glass treatment

- ❖ If the bottle is a non-disposable one, better return it to the retailers than recycle.
- ❖ Before taking it to the collection centre, rinse the bottles and jars.
- ❖ Whenever possible, remove the metals and plastic caps and corks from the bottles and jars.
- ❖ All glass container can be recycled. This includes containers for food, for medicines, etc.
- ❖ Bulbs and glass cookware should not be mixed with glass containers. They are made from glass of different characteristics than the glass used for the production of glass containers, so they can contaminate the mixture and yield a poor-quality final product. Flat glass, such as the one from windows, be it whole or broken, is, too, not supposed to be mixed with glass bottles.
- ❖ Make sure you separate the bottles according to their colours - colourless, brown and green. It is extremely important to make sure the colourless glass is not mixed with other colours, in the contrary, its value will significantly drop. Bottles made from blue glass can be mixed with the green one. Bottles wrapped in materials can be recycled as all additional materials will burn in the furnace.
- ❖ In the bins where you dispose of your glass, do not leave the bag or the box you used to bring your glass.

2. Other types of waste not mentioned elsewhere (metal, medical waste, hazardous waste)

Metal

Aluminium containers

Non-recycled (primary) aluminium is made from the bauxite ore. This method of aluminium production is expensive, it spends large quantities of energy, and a lot of bauxite. To production one ton of aluminium, four tons of bauxite. This is why aluminium recycling has many advantages. Production of recycled aluminium saves up to 95% energy, gas emissions are reduced by 99%, and also the quantity of landfilled waste is reduced. By recycling 1 kg of aluminium, we save 8 kg of bauxite, 4 kg of chemicals, and 14 kW of electrical energy. Aluminium can be recycled indefinitely, as the re-processing cannot destroy its structure. On a global scale, the recycling of bulk materials, such as aluminium parts of transport vehicles, exceeds 90%. Smaller items made from aluminium are recycled less. Cans and aluminium foils for households use are the tiniest and the most difficult to recycling, with a recycling rate of just 33%. *Aluminium cans* Aluminium cans are the most recycled container materials (50% of cans are recycled globally< in 2000, Sweden and Finland recycled 91% of their cans). Their monetary value is 6-20 times higher than for other container materials. Aluminium cans are easily recognized by the following characteristics:

- They are not attracted to magnet;
- Sometimes the bear the mark "ALU";
- They have a very shiny, silvery foundation;
- They are extremely light;

- They don't rust.

Aluminium foil

Aluminium foil and aluminium cans are made with different degrees of purity, so they should not be collected together. Most of the recycled aluminium foils are used for making molds in car industry, such as cylinder heads and engine blocks.

Following aluminium items are suitable for recycling and can be collected:

- Aluminium foil used as covers for sour milk and cream containers;
- Aluminium foil used as cover for cardboard containers (juice boxes);
- Aluminium molds used for baking or freezing;
- Kitchen foil;
- Cigarette and tobacco foil.

Those items that were in contact with food, should be washed before selecting. Metallized plastic bags, the ones that are normally used for packing crisps and other snacks, appear to be aluminium-made, but these are not recyclable. To check whether a bag is indeed made of aluminium foil, squash it with your hand. If the bag returns to its original form, this means it cannot be recycled, because the container is not made of aluminium. In certain packages, aluminium is used to protect the food from penetration of outside smells and flavours. Here, aluminium is placed between two layers of plastic, as is the case with coffee packages, or between a layer of plastic and a layer of cardboard, as is the case with milk and juice boxes. When these packages are melted, gasses are released that oxidize the aluminium, frequently destroying it, which makes the recycling of these packages difficult and expensive. The "tetra-pack" packages can be process into hard cardboard, which can then be used to make various products, such as office furniture and loudspeakers.

Hazardous waste from households

Household hazardous waste includes predominantly the following materials and items:

- Batteries;
- Fluorescent bulbs;
- Chemicals used at home and in the garden;
- Medicines;
- Oils;
- Dyes, glues, varnishes, thinners, and removers;
- Smoke detectors;
- Electric and electronic devices;
- Used vehicles.

Batteries

Although the various types of batteries can vary in their chemical composition, majority contain heavy metals, which are the main reason for environmental concern. If batteries are improperly disposed, these heavy metals can leach into the soil when the batteries corrode. This pollutes the soil and the water and endangers the entire wildlife. Cadmium, for example, may be toxic for aquatic invertebrates and accumulate in fish, rendering them unsuitable for human consumption. Some batteries, such as the tiny flat ones, contain mercury, which exhibits similar adverse characteristics. Mercury is no longer used

in the production of disposable batteries, except in the tiny flat ones. Major European battery suppliers have been offering mercury-free batteries since 1994.

Fluorescent and energy-efficient electric bulbs

Lighting with fluorescent bulbs is energy efficient. They spend 75-80% less energy than the standard bulbs and they last 8-10 times longer. Similarly, energy-efficient electric bulbs contribute for both saving the energy and saving the raw materials for their production, because they need to be replaced less frequently. However, fluorescent and energy-efficient bulbs, unlike the ordinary bulbs, contain mercury, which can be harmful to human health if it gets in contact with the skin, if its swallowed or inhaled. The mercury content is the most concerning issue around the use fluorescent lighting. A fluorescent tube 122 cm long may contain up to 30 mg of mercury. According to European standards, the maximum permitted mercury content in drinking water is 0.001 mg per 1 litre of water. As long as the mercury is contained within the bulbs, it poses no hazard, but if the bulbs are removed unprofessionally, both mercury and other heavy metals contained in the bulbs may be released in the environment and cause soil and water pollution. If penetrate the body, these substances may damage the liver, kidney, and even brain. In order to prevent the unintentional exposure to these substances, the used fluorescent and energy efficient bulbs should be stored in their original packaging and taken to a recycling centre. There are well defined recycling procedures for the used fluorescent bulbs. One of the most advanced techniques for their reprocessing includes disassembling the bulbs into its components, followed by mercury recovery. It is possible to recover the mercury up to 99% with a 99,98% purity. Mercury can then be resold to the industry to be reused in barometers, thermometers, etc. Glass and metal parts are also recycled, and are then sold to corresponding industries.

Chemicals used at home and in the garden – Some household chemicals, such as bleach and oven cleaners, have the potential to harm the environment. Moreover, many of the chemicals used in gardens can have adverse effects on the environment. This includes pesticides, herbicides and mineral fertilizers. Even though the best solution is to reduce their use or replace them with non-toxic alternatives, still, the use of these chemicals cannot always be prevented, especially where reserves of old chemicals exist. For both types, the major problem is related to the unintentional leakage, improper use or inadequate disposal of these chemicals. Households and garden chemicals should not be poured out into sewers, sinks, or toilets, because this will lead to waters pollution, especially if larger quantities are at stake. Similarly, during heavy rainfalls, chemicals used in gardens can escape into the surface water drainage and pollute them. This is why garden chemicals should not be used during the rainy seasons. Garden chemicals should be stored in their original packaging so as to make sure the instructions for use are always handy. An existing quantity of these chemicals should be used entirely, whenever possible, and all outstanding chemicals should be disposed of safely. If there are no instructions for disposal, it is recommended to contact the producer directly for further advice on their disposal. Recommendations for collection facilities should be sought from the local authorities. Empty containers from household or garden chemicals, due to residual oils they may contain, are not suitable for recycling, which makes them household hazardous waste.

Medicines

Many households keep stocks of medicines and pharmaceuticals long past their expiry dates, which have not been used for years. If you have such medicines, you should not mix them with other types of waste, or pour them out into drainage. This way you'll be sure they don't get in touch with children or animals, and you will prevent the soil and waters pollution that could follow. All unwanted pharmaceuticals should be stored in their original packaging, and should be returned to the pharmacist, who should know how to dispose of them safely. This waste will most likely be incinerated so as to prevent its further release into the environment.

Oils

Quite many oils are used in households on everyday basis. Majority originate from motor oils and oils used in nutrition. One quarter of all environmental incidents happening in England every year are caused by oils. Waste oils and fats from cooking, which come from commercial or industrial sources, may be collected and recycled. Upon purification, they can be used in animal feed, as promoters of its caloric value, or as soap ingredients or in cosmetics. This oil is also used for the production of biodiesel, which is used in vehicles. Waste oils from vehicles are discussed further in the text, in the part on used vehicles. If these oils are unintentionally or intentionally discharged in drainages or in sewers, they can contribute for a significant water and soil pollution. Oils create a film on the surface of rivers and lakes. This may drastically reduce the oxygen level in the water and threaten the entire aquatic wildlife. Large quantities of water are pumped out of rivers or groundwater to be used for drinking or irrigation. Oil pollution may render the water no longer suitable for this use. Soil polluted by oils may become infertile and unsuitable for use.

Dyes

Waste dyes, along with organic solvents and volatile organic compounds (VOCs) found in them are classified as hazardous waste. When VOCs react with sunlight, a ground-level ozone is formed, which is harmful to human health if inhaled in larger quantities. Dyes and dye thinners should not be discharged in the drainage as this will pollute the watercourses. If you have small quantities of dye left over, it would be best to let it dry out naturally, or use as an absorbent (newspapers, sawdust) so as to absorb whatever remains. Then, the packaging can be taken to the recycling centre.

Electric and electronic devices

Electric devices include the heavy home appliances that frequently go by the name of "white goods". Electronic devices include all the IT equipment or communication equipment, which mostly consists of computers, but a large share belongs to TV sets, too. The management of waste coming from electric and electronic devices is a significant issue, as these products are given an increasingly shorter useful life, meaning that an ever greater quantities of outdated or broken equipment will be disposed of. Electric and electronic devices take up around 4% of the municipal waste in Europe, and this quantity is increasing three times faster than the other categories of waste. Products listed in these category of waste do not only differ by the function they perform, but also by the materials they are composed of. For example, an average TV set is composed of 6% metal and 50% glass, whereas the electric stove contains 89% metal and only 6% glass. Other materials used include plastic, ceramic, and precious metals. The variety of products and materials is an obstacle in the reprocessing of electric and electronic equipment. Disposing of the electric and electronic devices into the landfills, or their incineration, raises a number of environment concerns.

Tips for hazardous waste:

- ❖ Reduce the quantity of hazardous waste by buying materials known to be less harmful or use alternative techniques, whenever possible; for example, use dyes, coatings, varnishes, glues, cleaning and maintenance products which are plant-based (such as rubber turpentine, oil extracted from lemon or orange peels), or water-based, or which contain less solvents.
- ❖ Buy rechargeable batteries. This will not only reduce the quantity of waste batteries in household garbage, but will also save energy, because the energy used to produce a battery is, on average, 50 times greater than the energy it gives.
- ❖ Use devices that can work on solar energy (through solar panels) or on wind energy.
- ❖ Buy only the things that you need. Buy the amount of pesticides and mineral fertilizers that will suffice for just one season.
- ❖ Always follow the use and disposal instructions.
- ❖ If a device got broken, see if you can repair it first, before disposing of it.
- ❖ Give the unwanted furniture and home appliances, such as ovens and refrigerators, to poor families, or donate them to charities, such as Red Cross, where they will be fixed and distributed for further use.
- ❖ When you drive a car, avoid the holes and curbs on the road, so that you can avoid damaging your tyres.
- ❖ Regularly check the air pressure in your tyres. The overinflated or underinflated tyres wear more easily and are susceptible to tearing.
- ❖ Regularly balance your tyres so that they will wear more evenly.
- ❖ Use your car as little as possible. Instead, try walking, riding a bike, or using the public transport.
- ❖ Buy vulcanized tyres.
- ❖ Don't use your tyres until excessively worn out. This can be dangerous, and later on it may be impossible to vulcanize them.

Involvement of pupils:

Let us remind ourselves what types of waste we generate. Then, talk to the pupils about the waste that we encounter on daily basis.

Exercise: Make a list of items and ask the pupils during the class to tell you which items belongs to what waste.

2. SECOND CLASS, Adverse effects of the waste on the environment and human health

Adverse effects of hazardous matters on the environment and the human health

A very important problem is the toxic nature of many substances, such as: arsenic, bromine, cadmium, hydrochlorofluorocarbon (HCFCs), lead, mercury, halogenic fire-resistant materials, including the polychlorinated biphenyls (PCBs). Refrigerators and freezer contain gasses, such as chlorofluorocarbon (CFCs) and HCFCs, which are used as coolers and insulators. Both these gasses contribute to the reduction of the stratospheric ozone. PCBs, and other halogenic fir-resistant materials are durable bioaccumulating toxic substances. They can cause damages to the nervous system, thyroid gland, and

are genotoxic, too. Their incineration produces dioxins and furans, which are the most toxic substances known to man. They can cause disorders in the nervous, immunological and endocrine system, they impede the sexual development, have a toxic effect on the liver, skin, spleen, and may even cause cancer and diabetes.

Effects of plastic on the environment

Plastic can have adverse effect on the environment both in the process of its production and during its use and disposal. Large quantities of fossil fuels are spent to produce plastic, both in the capacity of raw materials and energy required to execute the production process. It has been estimated that 4% of the annual production of crude oil is used as raw materials for the production of plastic, and additional 3-4% are used as energy resource for the production process. Moreover, the production of plastic requires water, and it creates wastes that are released as pollutants in the environment. The overall impact of plastic on the environment depends on its type. Some additional, potentially hazardous chemical substances can also be used during production of plastic – stabilizers, plasticizers, and dyes, the effects of which on the environment and the human health is yet to be studied. For many of these initial evidence exist that are harmful to particular organic systems in the human organism, and that are potential triggers for many diseases in humans. An example of such substances is the phthalates, which are used as softeners (plasticizers) in soft PVC. They have the capacity to “escape” from the product while used and upon its disposal. In this way, they become released in the environment and penetrate the living organisms. Phthalates may cause disorders in the hormonal and immunological systems. In the past, children toys were made from PVC, so children got directly contaminated with phthalates. Today, six types of phthalates are prohibited from use in toy production, and some countries have banned the production of toys from PVC altogether. Disposing of plastic, too, can have huge adverse impact on the environment. During incineration of PVC, for example, dioxin are released, the most toxic substances known to man. Plastic is also non-biodegradable, it takes hundreds of years to be degraded in the landfills. Plastic products, in particular plastic containers, are disposed of fairly soon after their production and purchase, which drastically increases the need for landfilling space.

Involvement of pupils:

Split the pupils in three groups and give them assignments to prepare presentations. One group should discuss the adverse effects of plastic waste on the environment; the other group should discuss the adverse effects of waste paper on the environment; and the third group should discuss the adverse effects of waste glass on the environment. In next class, present the presentations and comments, discuss.

Objective: Economic aspects for proper waste management

1. FIRST CLASS, Positive outcomes from waste reduction, reuse and recycling

If the disposed materials are not recycled, the production process will require the use of raw materials. This implies great loss of resources and serious harm to the environment. In 1998, it was estimated that resulting from the six million tons of waste electric equipment generated in Europe, the potential loss of resources had amounted to:

2.4 million tons black metals,
1.2 million tons plastics,
625,000 tons copper,
336,000 tons aluminium,
336,000 tons glass.

As an illustration, here is an example of the reuse of waste glass: By recycling one glass bottle we save energy required for:

- A 100 W bulb to work for 1 hour
- A computer to work for 25 minutes
- A TV set to work for 20 minutes
- Washing machines to work for 10 minutes.
-

We can say that by using recycled glass in the production of new glass containers contributes for energy saving, helps the production process of ceramics, allows for raw materials to be saved, and reduces the quantity of generated waste.

Moreover, there is also the loss of heavy metals, lead and mercury, fire-resistant materials, etc. Extraction of these raw materials and production of various items from them can seriously harm the environment in the process of their excavation, transport and energy use. The nature of many of these materials is such that they can be recycled relatively easily, thus avoiding the need to use and lose new raw materials.

Reduction, which means to reduce the quantity of waste at the source of its generation, is the first and most important step in the sustainable waste management. Reduction, in fact, is the rationalization of our needs, implying that we purchase only what we truly need and that we replace the products containing hazardous materials with new products more acceptable for the environment. Reduction requires that all waste generators, included, become more aware and more conscientious.

Reuse is yet another way to reduce the waste, and it means that we can use again the items for the same or an even altogether different purpose. In this way, not only do we reduce the waste, but we also make a maximum use of the available natural resources, which are limited in nature. Since, when reused, products don't change their form and they don't undergo the process of reprocessing, reuse saves energy, making it more environmentally acceptable than recycling. Reuse includes repairing, recharging and renovating our products and devices. Buying second-hand cars and mending our shoe soles is a commonplace practice, but many other items we use daily can also be fixed and have their useful life extended, instead of disposing of them. Giving a new life to our couches by providing new upholstery can prove a good alternative to buying new ones. Many supermarkets and shops sell

products in container that can be reused and refilled, such as liquid soaps, detergents, etc. This way we reduce the quantity of waste containers, and we ensure that the containers are used several times.

Recycling – recycling is the process of reprocessing the products found in waste, in which case they now serve as the raw materials for the production of new items. In this way, we slow down the exploitation of raw materials found in nature. Production of items from secondary raw materials spends less energy compared to production from primary raw materials, thus making the recycling an energy efficient process. Nearly half of the waste we generate could be recycled. 30% of the vegetable peels and other organic waste can be composted. Many products made from recycled materials are made up to the same quality standard which apply to products made from primary raw materials. This is particularly important from the point of view of market competitiveness. Similarly, the recyclate (the recovered material used as a replacement for raw materials) that has been used for making of new products, should be able to compete with the primary materials in terms of quality, consistency, availability, characteristics, and price. New technologies constantly improve the quality and the design of the recycled materials, and the improvement in the production process result in the production of many new recycled products. For example, recycled paper today has many similar characteristics with the high-quality paper produced from primary raw materials, and can be equally used in printers and photocopiers. The recycling process, as a whole, is completed when we buy products made from recycled materials, thus contributing to the further stimulation of this process and help close the cycle of matter.

Why reuse and recycling? It has been estimated that every ton of household waste generates additional 5 tons of waste in the production process and 20 tons of waste at the site of raw materials extraction. This need for raw materials, which is constantly increasing, reduces the global natural resources and the non-renewable energy reserves. On the other hand, adequate landfilling sites become more and more rare, and all the more expensive. Large portion of our waste is consisted of non-biodegradable components, glass, plastic, metal, which accumulate in the landfill indefinitely. During the anaerobic decay of biodegradable waste, significant quantities of carbon dioxide and methane are produced, and when these are released into the atmosphere, they contribute for the global warming. This waste type also contributes for the generation of filtrates, which mobilizes the toxic materials in the landfill and, if not treated properly, may endanger the local underground water basins and other watercourses; the effects of these processes on health have not yet been fully investigated. Incineration, too, is not the most adequate solution, since emissions from this process contain large number of toxic matters, heavy metals, dioxins and other materials harmful to the environment and humans. Solid residues from the incineration process also contain harmful materials that are later landfilled. This means that the problem of toxic materials in waste are not solved by incineration, on the contrary, new problems are generated.

Involvement of pupils: If possible, organize a visit to a collective waste treatment facility for a particular type of waste, or to a recycling facility, or to a waste transport and storage facility. Ask them to give you a short presentation. You can also invite them to your classroom and together discuss about recycling.

2. SECOND CLASS, Waste reuse workshop

Remind yourselves briefly about the need to reuse the waste. Then guide the class to work on preparation of materials so that they can use the materials brought from home.

Involvement of pupils: Prepare the pupils from home, ask them to bring empty plastic bottles, caps, plastic bags, glass bottles, jars, and other materials that have already been used. Present several ideas as to what can be made from it, and organize a competition. Award the first three places with symbolic prizes.

Use to following link to see what can be used from waste.

https://www.google.com/search?q=trash+for+art&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwjLxazarOjVAhXjdpoKHfh3AZwQsAQIJg&biw=1366&bih=616#imgdii=MRmrmiCqhLA_mM:&imgsrc=HDvIMy_vvmpEjM

Objective: What is biodegradable waste and why we need to compost it

1. FIRST CLASS, What is green waste, what is composting?

Food leftovers, paper, textile made from natural materials and organic waste from greenery all constitute biodegradable components of the waste. By landfilling them, we lose significant quantities of organic matter and energy, and we cause many adverse effects on the environment, as mentioned above.

By “green” waste we mean biodegradable households waste: fruit and vegetable leftovers and waste from greenery. Research has shown that this waste takes up great space in landfills. The most desirable way of treatment of the food leftovers from plant origin, as well as of the green waste from our gardens, is to compost them, whereas paper and textile are best to be recycled. Composting is the process whereby organic matters decompose with the help of microorganisms, bacteria, and fungi, in the presence of oxygen. The result of the composting process is the compost, which is safe to be stored, easy to handle, and environment-friendly.

Benefits from composting:

Compost improves the overall structure of soil;

It prevents water drainage by allowing the water to penetrate more easily into the deeper layers of the soil and remain there, instead of staying on the surface and draining away. By adding the compost to a particular plot, the water is better retained, and in cases of clay soil, the water is better drained;

Thanks to the compost, plant roots can penetrate more deeply into the soil and retain it, thus prevent the soil erosion;

Compost provides food for ground worms, insects and useful microorganisms;

It helps the soil preserve its nutrients, thus reducing the need for use of chemical fertilizers;

Compost yield healthier plants which are less susceptible to diseases, and in that way it reduces the need for use of pesticides.

2. How do we compost?

Composting is the natural and oldest method of waste disposal, but also of soil fertility promotion. The leaves we collect, the grass we mow, the branches we cut off, and all other household plant residues can be used for making a compost. The ready compost is dark and has a pleasant smell. The composting process is carried out in composters, which, for household use, can be easily made from planks. The composting pile can be simply layered or placed in specially constructed compartments, which, for this purpose, can be delimited with wooden beams, cement blocks, or metal wire. The good composting requires the application of the following rules:

- ✓ The carbon/nitrogen proportion should be approximately 4:1. To reach this proportion, the compost should contain adequate quantity of mixed dry leaves, sawdust, or other sources of carbon, mixed with manure, green leaves, or nitrogen-based mineral fertilizers.
- ✓ The compost must be supplied with microorganisms necessary to effectuate the composting process. These can be provided by adding few shovels of garden soil, or, by adding a compost which already contains microorganisms.
- ✓ The pile should be moist as a well-drained sponge, so, if necessary, water should be added.
- ✓ The pile should be turned periodically, so as to speed up the decomposing of the constituent components. The turning of the pile contributes to better aeration and faster decay.

Composting recipe:

The compost is most easily made following the next procedure:

- 1 Set the composter on the ground. Cover the bottom with a thin layer of twigs.
- 2 Add dry leaves up to 10-15 cm high, and cover them with vegetable residues and a bit of mown grass and, if possible, add green leaves, tea bags, coffee sediments, altogether in a 10 cm thick layer.
- 3 Cover the material by throwing a little bit of soil into the composter. Sprinkle some water so as to moisturize the ingredients.
- 4 Mix so as to make sure the brown and the green components are evenly spread throughout the entire material. Repeat the whole procedure two more times, until the composter is filled. At the end, cover the material with a thin layer of fallen leaves, soil or compost. After 7-10 day, use a garden tool to turn the compost.
- 5 Repeat the turning another 3-4 times, at a 7-10 day span. The material inside the compost must not be compacted; composting without air will make the material rot and stench. In a dry weather, occasionally sprinkle the compost material with some water; in a rainy weather, cover the composter, best with jute bag. In order to be able to compost over a longer period of time and to produce more compost, make sure to collect larger quantities of dry leaves in autumn.

Involvement of pupils: Ask them to think which things from their everyday life could end up composted, i.e. what materials can we use to compost?

2. SECOND CLASS, Make a school composter and set the rules for maintenance

In order to make a school composter, it is best to use the garden in your schoolyard. Discuss with the school director and janitor so as to find the best and safest location for your composter. With the assistance from the janitor, dig a 50-60 cm deep and 50 cm wide hole. Then, explain to the pupils that during the break they can leave here their food leftovers which can be identified as biodegradable and suitable for composting. Mark the opening of the composter with wooden stick or rocks. Also, remember to fence off the composter, so that no one gets hurt. From time to time, you or the janitor, can throw in some soil over the disposed biodegradable waste.

Explain to the pupils that next year this compost will transform into a natural fertilizer and will help us plant flowers in spring. The composter is best filled in the period between September and March/April, and then use the compost to plant new flowers in the next coming spring.

Print out the information about the composter and the rules for its maintenance and display it on the school bulletin board.

9TH GRADE LESSONS

Objective: To learn what hazardous waste is

1. FIST CLASS, What is hazardous waste?

Hazardous waste is the waste that contains substances that have one or more of the following qualities: reactivity, explosivity, inflammability, carcinogenicity, infectivity, mutagenicity, teratogenicity, toxicity, ecotoxicity, irritability, or the ability to emanate poisonous gasses through a chemical reaction or biological degradation, as defined in in List 1, 2 and 3 of the Law on Ratification of the Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

The hazardous waste from plant and animal production has an adverse impact on the environment. This waste is produced from the use of plant protection products and animal protection products, or from infected and deceased animals. The exact quantities of this type of hazardous waste are not known, but it is known for sure that it ends up thrown away in the environment. Since there is no classification system for hazardous and non-hazardous waste in our country, we have scarcity of data on the quantity and quality of the hazardous waste. It has been estimated that we produce an annual quantity of approximately 46,000 tons of hazardous waste, with a possibility to increase to 75,000 tons by 2025, and this estimation does not include the hazardous waste of industrial enterprises.

Hazardous waste is the waste that contains substances that have one or more of the following qualities: explosiveness, reactivity, inflammability, irritability, toxicity, infectivity, carcinogenicity, etc. Because of the hazardous substances contained in the hazardous waste, it poses a serious risk to the environment and human health, if not properly and safely managed. Certain economic sector produce hazardous waste, largest of which is the processing industry. Similar to other types of waste, the key elements of the safe management of hazardous waste are the introduction of a proper legal regulations, adequate training of the staff handling the waste, and public awareness raising.

The major quantities of hazardous waste (around 75,500 t/year) are produced by the industry and are disposed of at the industrial landfills. The smaller-scale hazardous waste generators produce around 2,000 t/year hazardous waste, out of which 1,300 t are sold/recycled, and the remaining waste is disposed of in the perimeter of the installation, or mixed with the municipal waste. There are no officially authorized collectors and transporters of hazardous waste. It is also assumed that certain generators and their waste are not covered by these reports, and the quantity of hazardous waste they produce is estimated to around 500 t/year. The local deposits of hazardous waste are environmental hotspots because of their impact on the environment.

Hazardous waste poses a greater risk for the environment and human health than the non-hazardous waste, which is why a strictly controlled regime is required for its management. The major principles that the hazardous waste management relies on are reduction of hazardous waste production, safe

transportation of hazardous waste, reduction of the level of hazard of the produced waste, and proper treatment.

Polychlorinated Biphenyls (PCB), too, constitute a type of hazardous waste and they belong to the group of synthetic chemicals known as Persistent Organic Pollutants (POPs) PCB were massively produced from 1930s to 1980s. They feature a great chemical stability and heat resistance, so they were widely used as components in electric and hydraulic equipment, as well as lubricants. They are used as liquid dielectrics in closed-circuit applications of electrical equipment, such as transformers, condensers, hydraulic systems. They can also be found in industrial oils, dyes, glues, plastics, etc.

PCB have been classified as possible human carcinogens and producers of a variety of adverse effects in humans and in animals, including reproductive toxicity, immunotoxicity and teratogenicity. Via certain environmental media, such as groundwater and surface water, soil, and even in food, PCB can be transported to great distances and be detected in places far from their production or use.

Lubricant oils are a product typically used in our everyday lives, making it possible for our engines and machines to function properly. During their use, oils lose their properties and become contaminated. Once they have been utilized over a period of time, these oils are typically substituted with new lubricant oils.

Waste oils belong to the group of hazardous waste because of their adverse characteristics. Waste oils disposed of in rivers and lakes pose a risk to the living organisms in the water. A single litre of waste oil can contaminate million litres of water. Soil contamination appears when waste oils are poured out over the land surface.

Medical waste is also a type of hazardous waste. The separated collection of medical waste in hospitals and other healthcare facilities is implemented across our country at a very slow pace. Only around 35% of the hazardous medical waste is collected separately, and then transport and incinerated in the Drisla landfill, whose service provision normally covers the wider Skopje area (360 t/year). The remaining 65% of hazardous medical waste is disposed of in municipal waste landfills or in unauthorized landfills.

Involvement of pupils: Let us remind ourselves what types of waste we generate. Then, talk to the pupils about the waste that we encounter on daily basis. Let the teacher list a number of hazardous waste types, too. Ask the pupils to say which of these waste types they meet in everyday life.

Exercise: Draw up a list of products and ask the pupils if they can classify their waste as hazardous and non-hazardous.

Objective: Waste and employment

1. FIRST CLASS, Positive outcomes from waste reuse and recycling and creation of new jobs

Waste recycle opens new jobs for professionals who are qualified to carry out the recycling and repairing activities, and it also creates new markets for the valuable components recovered from the waste.

The waste recycling material can generate 5-7 times more jobs than what is normally required for the waste incineration process, and even 10 times more new jobs than what is normally required for landfilling. The thematic EU strategy for waste prevention and recycling considers that the waste management and recycling sector in EU27 provides a total of 1.2-1.5 million jobs. To better explain it, for every 1,000 tons of waste electronics:

- Landfilling – requires one or less jobs
- Recycling – requires 15 newly opened jobs
- Repairing – requires 200 newly opened jobs (on the other hand, this activity offers an additional opportunity for students and low-budget families – a possibility to buy inexpensive computers).

Involvement of pupils:

Split the pupils in groups and give them tasks to imagine company of their own dealing with waste management. Pupils should indicate what type of waste their company will be handling, whether it is going to be recycled, collected or incinerated. Have a look at the website of the Ministry of Environment to see what types of operators there are according to the legal regulations.
http://www.moepp.gov.mk/?page_id=2699

Objective: To educate the younger generations

1. FIRST CLASS, Organization of presentations (guidelines, preparation, selection of audience) – a total of 2 presentation throughout the entire school year

The aim is for 9th grade pupils to participate in development and presentation of information on waste management. Presentations may include anything from the entire programme from the 6th to the 9th grade. In class, develop the presentations, organize the contents, and agree on presentation methods.

Involvement of pupils: Help the pupils organize the presentations (to choose which grades they will present to, to select a topic related to waste, to prepare the presentations).

Literature:

1. Legislation

1.1. Law on waste management of the Republic of Macedonia

1.2. Law on waste management of the Republic of Bulgaria

2. Publications:

Депонирање на отпад, прирачник со општи совети, Министерство за животна средина и просторно планирање, Скопје 2012

Guidance on municipal waste data collection, Eurostat – Unit E2 – Environmental statistics and accounts; sustainable development, Mas 2017

Guidance on applying the waste hierarchy, Department for Environmental Food and Rural Affairs, June 2011

Municipal Waste Management in Bulgaria, European Environmental Agency, February 2013

Razumjeti otpad, prirucnik za podizanje svijesti, Zelena Akcija, Zagreb, travanj 2012

Статистика на животната средина, Државен завод за статистика, 2015