TREE
Micro- and project-based learning programme for Teaching ciRcular Economy and Ecological awareness in VET

Funded by the European Union

TRAINING LESSON 2 - Part 2 (Plastic sector)

Title	a. Types of plastics and microplastics
Part of the training course referred to in this lesson	b. □ Part 1 General information about sustainability and CE Part 2 Specific Information about: □ Wood sector X Plastic sector □ Agrifood sector
EQF level	Level 2 or Level 3, in case of doing the optional tasks.
Where the lesson was tested	//
General Learning objective(s) according to the Bloom Taxonomy	□ **Create** Produce new or original work (design, assemble, construct, investigate, formulate) □ **Evaluate** Justify a stand or decision (appraise, argue, defend, critique, select, support) □ **Analyze** Draw connections among ideas (differentiate, organize, relate, compare, distinguish, test, experiment) □ **Apply** Use information in new situations (execute, implement, solve, use, demonstrate, operate) X **Understand** Explain ideas or concepts (classify, discuss, describe, identify, locate, translate) □ **Remember** Recall facts and basic concepts (define, duplicate, list, memorize, repeat)
Specific learning objective(s)	• To understand what plastics are • To learn about the types of plastics • To understand what makes plastics dangerous for the environment. • To understand what microplastics are and what are the environmental problems related to them, as well as how they affect human health.

Cognitive, socioemotional and behavioural outcomes	**SDG 3 Good Health and Well-being** Cognitive learning objectives: The learner understands the socio-political-economic dimensions of health and wellbeing and knows about the effects of advertising and about strategies to promote health and well-being **SDG 4 | Quality Education** Cognitive learning objectives: ● The learner understands the important role of culture in achieving sustainability. ● The learner understands that education can help create a more sustainable, equitable and peaceful world Socio-emotional learning objectives: ● The learner is able through participatory methods to motivate and empower others to demand and use educational opportunities. ● The learner is able to recognize the intrinsic value of education and to analyse and identify their own learning needs in their personal development. ● The learner is able to recognize the importance of their own skills for improving their life, in particular for employment and entrepreneurship Behavioural learning objectives: ● The learner is able to contribute to facilitating and implementing quality education for all, ESD and related approaches at different levels. 2 ● The learner is able to use all opportunities for their own education throughout their life, and to apply the acquired knowledge in everyday situations to promote sustainable development **SDG 12 | Responsible Consumption and Production** Cognitive learning objectives: The learner understands how individual lifestyle choices influence social, economic and environmental development. Socio-emotional learning objectives: ● The learner is able to envision sustainable lifestyles. ● The learner is able to feel responsible for the environmental and social impacts of their own individual behaviour as a producer or consumer. Behavioural learning objectives: ● *The* learner is able to plan, implement and evaluate consumption-related activities using existing sustainability criteria. ● the learner is able to take on critically on their role as an active stakeholder in the market.
Green skill(s) addressed	XCreative problem-solving □ Management skills □ Forward-thinking X Impact quantification

	X Monitoring skills	X Life-cycle management
	X Analytical skills	X Science skills
	□ Lean production	□ Waste management
	X Maintenance and repair skills	□ Environmental auditing
	X Pollution prevention	□ Ecosystem management
	X Eco-design	□ Other_____
Duration	20 minutes	
Structure and content of the lesson	**Introduction** Plastics are a group of materials, either synthetic or naturally occurring, that may be shaped when soft and then hardened to retain the given shape. Nowadays, we use plastic products many times every day. From food foil, bottles, bags to glazing and clothing. Plastic can be flexible or rigid, transparent or opaque. It can look like leather, wood or silk. It can be turned into toys or heart valves. There are over 10,000 different types of plastic. Plastics are mainly derived from crude oil, gas and coal. Plastics are polymers. Polymers are long chains of repeating molecules (called monomers). The chain is made by joining, or polymerizing, at least 1,000 links together. Polymerization can be demonstrated by making a chain using paper clips or by linking many strips of paper together to form a paper garland. The name of plastics is derived from the prefix poly- and the chemical name of the molecule /monomer/. **TOPIC 1: TYPES OF PLASTICS** Isn't plastic all the same? Long story short … no. However, it's understandable that many people make the assumption that it's one material, all the same from top to bottom. In fact, there are hundreds of types of plastic (also called polymers), but only a handful that we interact with on a regular basis. There are many types of plastics but we will consider only the most widely used ones. **PET** polyethylene terephthalate - It is mostly used for food and drink packaging purposes due to its strong ability to prevent oxygen from getting in and spoiling the product inside. PET bottles are the most widely recycled plastic in the world **HDPE** Technical name - High-Density Polyethylene – it's an incredible resistant resin used for grocery bags, milk jugs, recycling bins, agricultural pipe, but also playground equipment, lids, and shampoo bottles among others. HDPE is	

	accepted at most recycling centers in the world, as it is one of the easiest plastic polymers to recycle. **PVC** - Polyvinyl chloride is the world's third-most widely produced synthetic plastic polymer. PVC is largely used in the building and construction industry to produce door and window profiles and pipes (drinking and wastewater). When mixed with other substances, It can be made softer and more flexible and applied to plumbing, wiring, and electrical cable insulation and flooring. Thanks to its versatile properties, such as lightness, durability, and easiness of processability, PVC is now replacing traditional building materials like wood, metal, concrete, rubber, ceramics, etc. in various applications. PVC is still hardly recyclable and should therefore be avoided, whenever possible. **LDPE** - It has the simplest structure of all the plastics, making it easy and cheap to produce. Used in plastic bags, six-pack rings, various containers, dispensing bottles, and most famously for plastic wraps, is not often recycled. **PP** - Polypropylene is the second-most widely produced commodity plastic. Hard and sturdy, it can withstand high temperatures and is found in tupperwares, car parts, thermal vests, yogurt containers, and even disposable diapers. **PS** - Polystyrene can be solid or foamed. It is a very inexpensive resin per unit weight and easy to create, for these reasons it can be found everywhere: from beverage cups, insulation, packing materials to egg cartons and disposable dinnerware. Perhaps better known by its commercial name – Styrofoam – it's highly inflammable and dangerous as it can leach harmful chemicals, especially when heated (which often happens because, as it's found in disposable take-out containers, people often microwave it to heat up the food inside it). Environmentally-speaking it's among the worst types of plastic: first, it is regarded as not biodegradable. Second, polystyrene foam blows in the wind and floats on water, due to its low specific gravity. Animals do not recognize it as artificial and may mistake it for food causing serious effects on the health of birds or marine animals that might swallow it. In addition, polystyrene is not accepted in recycling programs. To sum up, it's a no-go. **OTHER PLASTIC** - If plastic cannot be identified in the six types above-mentioned, then it will be included in group number 7. The best-known plastics of this group are polycarbonates (PC) used to build strong, tough products. Polycarbonates are commonly used for eye protection in the creation of lenses for sunglasses, sport and safety goggles. But they can also be found on mobile phones and, more frequently, in compact-discs (CD). In order to ensure easier identification of plastics, international standards have been adopted for the marking of plastic products. The marking sign is the symbol for recycling and a number inside it, if possible, the letter abbreviation of the plastic is also written.

TOPIC 2: WHY ARE PLASTICS DANGEROUS FOR THE ENVIRONMENT?

Although plastics are obtained from natural products - oil, gas, coal, they go through chemical changes as a result of various chemical reactions. Microorganisms take care of breaking down the matter. Plastic, as a product of the chemical industry, is not biodegradable. The only "degradation" of plastic occurs over time, as a result of its aging property.

Aging of plastic occurs under the influence of sunlight, in which it loses its elasticity, becomes brittle and crumbles into small pieces. Therefore, the degradation time of plastics is 400-1000 years. In recent years, options have been sought to create biodegradable plastics and microorganisms to break down the polymers.

TOPIC 3. MICROPLASTICS

Since the beginning of mass production of plastic 60 years ago, humankind has produced over eight billion metric tons of plastic. Only 9% has been recycled and another 12% has been incinerated. The rest, almost 80% of the plastic created so far, is in landfills or in nature, eventually ending up in rivers, streams and oceans. Plastic pollution has become a huge problem, but one of the most intractable forms of ocean pollution is microplastics. Plastic does not biodegrade, but breaks down into smaller and smaller pieces, resulting in microplastics less than 5mm in size. Much of the hundreds of millions of tons of plastic waste in our oceans is made up of microplastics. These tiny pieces of plastic, between the size of a virus and an ant, can now be found all over the world: in the water of lakes and seas, in the sediments of rivers and deltas, and in the stomachs of organisms ranging from zooplankton to whales. Microplastics have been found in environments remote from human activity, such as a Mongolian mountain lake and deep-sea sediments deposited five kilometers below sea level. One study estimates that on average, there are 63,320 microplastic particles in every square kilometer of the world's oceans.

Microplastics affect the environment in many ways, their research continues to this day. The environment in or around rivers is exposed to threats from microplastic pollution. Organisms as small as zooplankton can ingest microplastics. If ingested, it can block organisms' gastrointestinal tracts or trick them into thinking they are full, leading to starvation. Many toxic chemicals can also stick to the surface of plastic and, if ingested, contaminated microplastics can expose organisms to high concentrations of toxins. As more microplastics fill our marine environment and are consumed by the creatures that inhabit our waters, plastic particles enter our food chain. Ultimately, one

must consider the risks that microplastics pose to human health through the consumption of contaminated food. In addition to seafood, emerging evidence shows that microplastics, especially synthetic fibers, are found in a variety of foods, including drinking water, beer, honey, sugar and table salt. The presence of microplastics in foodstuffs can potentially increase direct human exposure to plastic-related chemicals and may pose a risk to human health.

In the late 1990s, cosmetics and personal care product manufacturers began marketing "microbeads" as abrasives in skin cleansers, toothpastes, shaving creams, and similar products. Researchers monitoring water quality have begun to detect microbeads in public water reservoirs and natural environments.

Increasing evidence indicates that fibers from synthetic fabrics are a significant source of secondary microplastics commonly found in wastewater and the aquatic environment. Experiments show that more than 1,900 microplastic fibers are released from a single synthetic garment with just one wash in a washing machine.

Another source of microplastic pollution is plastic debris from mechanical abrasion of car tires on pavement, which is washed by rain, snowmelt and street cleaning into natural and municipal drainage systems.

Microplastic pollution has been detected in human blood (Damian Carrington, March 2022) for the first time, with scientists finding the tiny particles in almost 80% of the people tested. The discovery shows the particles can travel around the body and may lodge in organs. The impact on health is yet unknown. However, researchers are concerned as microplastics cause damage to human cells in the laboratory and air pollution particles are already known to enter the body and cause millions of early deaths a year.

Many governments are introducing laws to ban the sale and distribution of cosmetic products containing plastic microbeads. Bead production will be completely banned.

The European Union, through its MERMAIDS project, is working to tackle the problem of microplastic fibers released by textile washing processes into European waters. The project investigates different technologies that can capture the fibers released in the washing process or prevent the breakage of clothing fibers through innovative textile or detergent additives.

In September 2015, world leaders agreed on a specific goal to "prevent and significantly reduce marine pollution of all kinds, especially from land-based activities, including marine litter and nutrient pollution" by 2025 (Goal 14.1 of SDGs) from the Sustainable Development Goals (SDGs). However, the indicators to be used to monitor the progress towards this goal are currently being developed by governments and stakeholders.

Conclusion

Plastics are an integral part of our daily life. Their diversity and widespread

	distribution are already a fact. The pollution of ecosystems has reached critical limits and the next process is already underway - the transformation of plastics into microplastics. It is our responsibility to change our way of life and thinking and to start living responsibly towards nature and towards ourselves. This is only possible with the help of waste recycling and the introduction of the circular economy to reduce the levels of human-generated plastic waste.
References	A&C plastic Inc, 7 Different Types of Plastic https://www.acplasticsinc.com/informationcenter/r/7-different-types-of-plastic-and-how-they-are-used Damian Carrington, March 2022 Microplastics found in human blood for first time Microplastics found in human blood for first time | Plastics | The Guardian Faye Haslam, 2022, The big problem of microplastics The big problem of microplastics - University of Nottingham - The University of Nottingham Group of Chief Scientific Advisors, June 2019, Environmental and Health Risks of Microplastic Pollution https://ec.europa.eu/info/sites/default/files/research_and_innovation/groups/sam/ec_rtd_sam-mnp-opinion_042019.pdf UNEP FRONTIERS 2016 REPORT, Microplastics: Trouble in the Food Chain https://wesr.unep.org/media/docs/early_warning/microplastics.pdf
Interactive questions for R3	2. Plastic packaging must be marked with a sign indicating the type of plastic **True** False 3. Which plastic is light, easily blown away by the wind, and npn recyclable PP PET PVC **PS** 4. Microplastics are products with small dimensions, a product of nanotechnology True **False**
Keywords	Plastic, polymer, microplastic

Questions for reflection	1. WATCH THE VIDEO WITH THE STUDENTS AND DISCUSS THE DIFFERENT PATHS OF PLASTIC BOTTLES What really happens to the plastic you throw away - Emma | TED-Ed 2. THE STUDENTS READ THE ARTICLE AT HOME AND HAVE A DISCUSSION IN THE CLASSROOM. **5.** HTTPS://WWW.NATURE.COM/ARTICLES/D41586-021-01143-3
Additional resources	**AIMplass, 03/2019, Classification and identification of plastics** https://www.aimplas.net/blog/plastics-identification-and-classification/ **Plastics for change, Aprel 2021, THE 7 DIFFERENT TYPES OF PLASTIC** https://www.plasticsforchange.org/blog/different-types-of-plastic **Wasser 3.0, Background and overview of microplastics** Microplastics - Wasser 3.0 (wasserdreinull.de) **UN Environment Programme, November 2019, How microplastics affect your health** How microplastics affect your health - YouTube **Wasser 3.0, March 2022, Good to know: Primary Microplastics Typ A and Typ B** https://www.youtube.com/watch?v=8MyRiG2ih_U&t=13s **Wasser 3.0, March 2022, Good to know: Secondary Microplastics** https://youtu.be/AZGYKnW8EUw
Icons & related info for the hints of the PowerPoint presentation	This hint is used to indicate that there's a link to other websites with additional information. This is used within the PPT to indicate that something important is written/ to invite the reader to pay attention to essential information.

	 It indicates a question for reflection
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