GREENDIVING

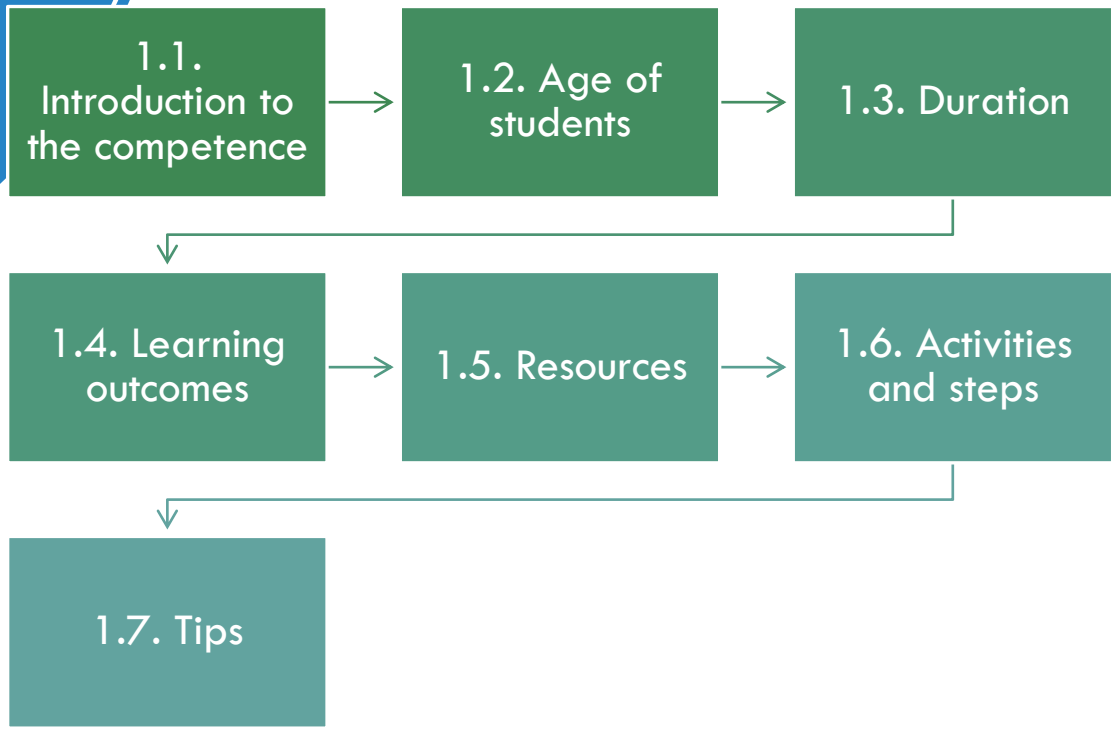
Project Green Diving

Unit 6: MICROPLASTICS IN MARITIME AREAS

Funded by the European Union

Index:

1. THE CLASS PLAN:



1.1. INTRODUCTION TO THE COMPETENCE

Briefly description of learning outcomes of the students and the theory contents of the class plan.

Learning Objectives

- To understand the definition and types of microplastics.
- To identify the sources and conditions of microplastic pollution.
- To explore the pathways and transport mechanisms of microplastics in marine ecosystems.
- To understand the interactions between microplastics and marine organisms, including their uptake and bioaccumulation.
- To identify and assess the impact of microplastics on the environment and human health.
- To understand the importance of public awareness and education campaigns in managing microplastic pollution.
- To analyze current scientific knowledge gaps and ongoing research efforts related to microplastics in the marine sector.
- To develop strategies for effective communication and stakeholder engagement in addressing microplastic pollution.
- To synthesize and apply acquired knowledge to propose innovative solutions and recommendations for microplastics management in the maritime sector.

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Learning Objectives

- To analyze different strategies for reducing microplastic pollution.
- To investigate technological innovations and methods for the detection and quantification of microplastics.
- To investigate monitoring techniques and sampling protocols to assess microplastic pollution in the marine environment.
- To analyze the socioeconomic impacts of microplastic pollution on coastal communities and industry.
- To examine case studies and best practices for managing and mitigating microplastic pollution in the marine environment.
- To critically evaluate the effectiveness of existing regulations and policies to control microplastic pollution.
- To examine how laws and policies can help to control the pollution caused by microplastics.
- To assess the potential risks and ecological consequences of microplastic pollution on marine ecosystems.
- To discuss international collaborations and initiatives to address microplastic pollution in the marine environment.
- To examine the role of sustainable practices, circular economy, and waste management strategies in reducing microplastic pollution.

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TARGET GROUP

- **Environmental scientists and researchers: t**his course is suitable for professionals in the field of environmental science and research interested to acquire an in-depth knowledge of the impact of microplastics in the marine environment. It will provide with the necessary information and tools to investigate, monitor and mitigate microplastic pollution.
- **Maritime industry professionals:** professionals working in the maritime sector, including shipping companies, port authorities, aquaculture and fisheries, offshore industries (oil and gas, renewable energy) and related sectors, will benefit from this course. They will acquire a comprehensive understanding of microplastic pollution and learn to implement sustainable practices and comply with regulations**.**
- **Environmental policy makers and regulators:** Government officials, policy makers, and regulators involved in environmental protection and marine resource management can also increase their knowledge of microplastics through this course. They will develop effective regulations and actions to address the problem of microplastic pollution in maritime sector.

TARGET GROUP

- **Educators and Trainors**: Teachers, professors, and instructors working in environmental studies, marine science, and related disciplines can use this course to enhance their curriculum. It will provide with up-to-date information and case studies that will enable them to educate and train students on the topic of microplastics in the marine environment.
- **Conservation and environmental NGOs:** non-governmental organizations working in marine conservation, environmental protection and sustainable development can benefit from this course. It will provide with expertise and strategies to combat microplastic pollution effectively.
- **Students and researchers:** undergraduate and graduate students, as well as researchers studying marine biology, environmental science, oceanography, and related fields, will benefit from this course. It provides a solid foundation for understanding the complexities of microplastic pollution in the maritime sector, enabling them to conduct efficient research and contribute to solutions.

Main results of the Green Diving project:

Digital Toolkit for Green Skills	**This result consists in the development of a digital toolkit which intends to offer a series of tools, materials and resources that will enable VET maritime teachers and VET maritime schools to integrate, explore and develop green and sustainability skills within macro level (school level) and micro level (classroom/students' level).**
Green Skills Course for VET Teachers Professional Development	**In this result, an online training course for maritime VET teachers and school directors will be developed in order to actively capacitate them to foster green skills, sustainability, and climate awareness.**
Action Plan for Greener VET Maritime	**Co-design an action plan for greener VET maritime schools which will define measures, steps, initiatives, changes needed and action lines to answer such**

INDEX OF THE COURSE

Class Plan

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1.1. INTRODUCTION TO THE COMPETENCE

Brief description of the contents.

1.1. INTRODUCTION TO THE COMPETENCE

In this unit, learners will expand their knowledge about the microplastics in the maritime areas and how to reduce its impact on marine environment and gain skills about waste management.

This unit was broken into several study and discussion groups:

1) History of Microplastics: The Development of Plastic
2) Plastic Waste and Pollution
3) Microplastics: Legislation and Regulations
4) Occurrence of microplastics: Types and Characteristics
5) Primary and secondary sources of microplastic pollution
6) What are macroplastics?
7) Microplastic identification techniques
8) Impact of Microplastics

Activity: Topics for Discussion

1. Have you ever tried to discuss the problem of microplastics with your students?
2. Do you think it's important to make students aware of microplastic pollution as soon as possible?
3. Have you already conducted a workshop with your students on microplastic pollution? If so, can you share your experience?

INTRODUCTION TO THE COMPETENCE: PRELIMINARY DISCUSSION

1. When did the concept of microplastics first come to the attention of scientists and researchers? How has our understanding of microplastics evolved since then?
2. Do you have any information about the historical development of plastics? When were plastics first invented, and what were their initial purposes and applications?
3. What changes have occurred in the manufacture and usage of plastics over time? Is there any noteworthy event or milestone that has shaped the plastics industry?
4. What were some of the important advances in plastic manufacturing methods that contributed to the growth of plastic products in many industries?
5. How have plastics become an integral part of our daily lives? Can you provide examples of common plastic products and their widespread usage in different industries?

6. What impact did WWII play in the fast rise of plastic manufacturing? What impact did the war influence the creation and demand for plastics?

7. Is there any important historical incident or event that has raised attention to the environmental implications of plastics, particularly microplastics pollution?

8. How have regulations and policies evolved over time to address the challenges associated with plastic pollution? Can you highlight any significant international agreements or initiatives aimed at mitigating the impact of plastics on the environment?

9. Are there any historical case studies or examples of successful efforts to reduce plastic consumption or manage plastic waste? What lessons can we learn from these experiences?

10. Looking to the future, what are some potential developments or innovations in plastics and materials science that may help mitigate the issue of microplastics pollution? Are there any promising emerging technologies or alternative materials?

THE THEORETICAL BACKGROUND BEHIND THE PROBLEM: HISTORY OF MICROPLASTICS

- The history of mankind has often been characterized by the materials used for making tools and necessities. The Stone Age, Bronze Age, and Iron Age are well-known periods that define human development. In the modern era, it can be argued that we are in the Plastic Age. Plastics, relatively new materials, have been in existence for just over a century. The first synthetic plastic, called "Bakelite," emerged in the early 20th century and found applications in various household items. However, it was after World War II that mass production of plastics began, with annual production reaching 5 million tonnes in the 1950s (https://doi.org/10.1098/rstb.2009.005)

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HISTORY OF MICROPLASTICS: THE DEVELOPMENT OF PLASTIC

Plastics gained popularity due to their lightweight, strength, low cost, durability, and resistance to corrosion. They are versatile and can be used to create a wide range of products, from flexible to rigid items, adhesives, foams, and fibers. Consequently, plastic production surged, reaching 30 million tonnes in 1988 and a staggering 359 million tonnes by 2018.

Plastic is composed of synthetic or semisynthetic organic polymers. These polymers have a unique molecular structure, forming long chain-like molecules with repeating chemical units. Typically derived from fossil oil or gas feedstocks, these units are composed of hydrocarbons. There is a vast variety of polymers, including polyethylene, polyvinyl chloride, polystyrene, and polypropylene. Additives like fillers, plasticizers, flame retardants, stabilizers, antimicrobial agents, and colorings can be incorporated to enhance performance and appearance

(https://doi.org/10.1098/rstb.2008.0304)

Plastic's success as a material has significantly influenced the development of modern society, challenging the use of traditional materials in various domains. Its benefits are particularly evident in healthcare, agriculture, transportation, construction, and packaging industries.

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Activity: Preliminary discussion

1. What are our society's principal sources of plastic waste? Can you name some main sectors or industries that significantly contribute to plastic pollution?
2. What are the environmental effects of plastic trash on ecosystems on land and in water? Can you give particular examples of how plastic pollution has had a disastrous impact on wildlife and habitats?
3. What are the obstacles in managing and disposing of plastic waste? Are there any significant disparities in waste management strategies between areas or countries?
4. Could you describe the concept of the plastic waste hierarchy and its significance in the fight against plastic pollution? What are the most important phases in this hierarchy, and how do they help to reduce the impact of plastic waste?
5. How does plastic waste contribute to marine pollution? What are some of the pathways through which plastic waste enters marine environments, and what are the consequences for marine ecosystems?
6. What are some of the existing legislative and regulatory measures in place to combat microplastic pollution? How effective have these regulations been in reducing microplastics in different environments?
7. What are the different types and characteristics of microplastics found in various environment?

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Plastic Waste and Pollution:

Plastic waste and pollution have increased significantly as plastic production has increased. Plastics have a long life cycle and can survive in the environment for hundreds of years before degrading. Plastic garbage has accumulated in landfills, water bodies, and marine habitats as a result of improper disposal and poor waste management systems. Plastics degrade over time into tiny particles known as microplastics, which are less than 5mm in size. Microplastics are of special concern since they are ubiquitous in the environment and can harm ecosystems and organisms.

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Microplastics: Legislation and Regulations

- The environmental impact of plastics has prompted the development of legislation and regulations to address plastic pollution. Governments and international organizations have acknowledged the need for action and have taken a variety of initiatives. These include restrictions on microbeads in personal care items, restrictions on single-use plastics, promotion of recycling and waste management methods, and the construction of marine protected areas. Furthermore, worldwide programs and agreements, such as the United Nations Environment Programme's Clean Seas campaign and the Basel Convention, seek to address global plastic pollution.
- Plastics have provided countless benefits to humanity, but they have also posed substantial issues, particularly in terms of waste and pollution. Recognizing the urgency of the problem, governments, organizations, and individuals are increasingly adopting initiatives to reduce plastic pollution through legislation, waste management improvements, and the promotion of environmentally friendly habits. Additional efforts are required to develop new solutions and tactics that reduce the environmental impact of plastics while promoting a more sustainable future.

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Occurrence of microplastics: Types and Characteristics

The occurrence of microplastics encompasses various types and characteristics that are important to understand in order to address the challenges associated with microplastic pollution.

Microplastic Types: Microplastics are divided into several types based on their origin and physical properties. The following are the most common types of microplastics:

Microbeads are microscopic spherical plastic particles that are commonly found in personal care products such as face washes and toothpaste.

Microfibers are tiny synthetic fibers that shed from textiles during laundering and wear and tear. They are commonly found in clothing items made from materials such as polyester, nylon, and acrylic.

Fragmented microplastics result from the breakdown and degradation of larger plastic items such as bottles, bags, and packaging materials. Due to environmental pressures such as UV radiation, wave action, and mechanical abrasion, these bigger plastics gradually fragment into tiny pieces

(https://doi.org/10.1016/j.jclepro.2018.12.256)

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Characteristics of Microplastics:

Size: Microplastics are described as particles with a diameter of less than 5mm. They might be as small as a few micrometers or as large as several millimeters.

Shape: Microplastics exhibit diverse shapes, including fragments, fibers, films, and irregular particles. The shape of microplastics can influence their behavior in aquatic environments and interactions with organisms.

Density: The density of microplastics varies, which influences their vertical distribution in water bodies. Some microplastics float on the water's surface, while others are denser and sink or remain suspended in the water column.

Surface Chemistry: Microplastics' surface chemistry can influence their interactions with chemicals and organisms in the environment. Microplastics have hydrophobic qualities, which allow them to absorb and accumulate additional contaminants such as (persistent organic pollutants) POPs and heavy metals.

Understanding the different forms and properties of microplastics is critical for determining their prevalence and impact in aquatic environments. Researchers, policymakers, and stakeholders can design effective solutions to decrease microplastic pollution and protect marine habitats by recognizing diverse origins and forms of microplastics. Furthermore, understanding the properties of microplastics aids in the development of detection and monitoring systems, as well as the assessment of potential ecological and human health risks associated with microplastic exposure.

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Activity: Preliminary discussion

1. What are the primary sources of microplastic pollution in our environment? Can you give some examples?
2. What are some secondary sources of microplastic pollution, in addition to primary sources? What are some examples of secondary sources and how do they contribute to the existence of microplastics in the environment?

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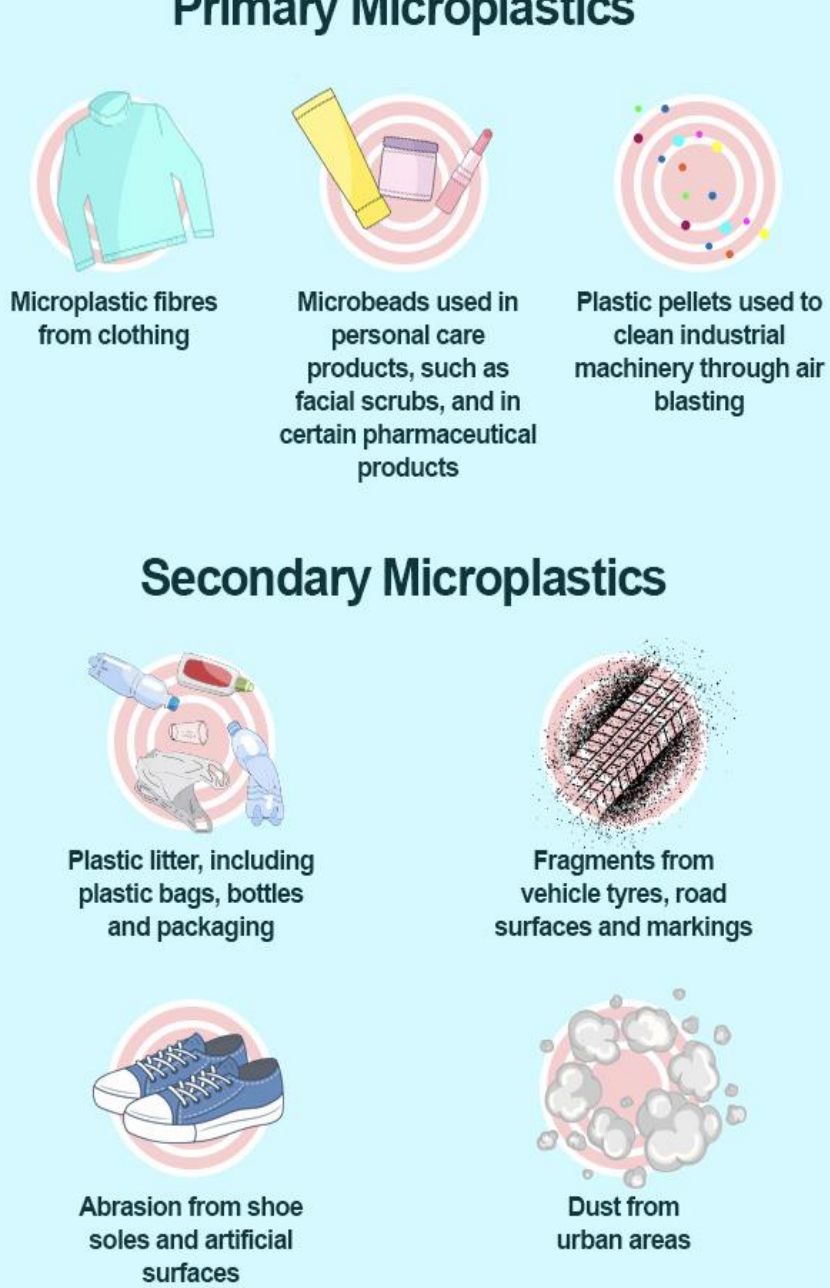

Primary and secondary sources of microplastic pollution

- ***Primary Sources:***
- **Fragmentation of Larger Plastics**: The fragmentation of larger plastic products, such as bottles, bags, packaging materials, and other plastic debris, is a substantial primary source. Exposure to environmental elements such as UV radiation, wave action, and mechanical abrasion causes these polymers to break down into smaller bits over time, eventually transforming them into microplastics.
- **Industrial processes:** Microplastics are released into the environment as a result of industrial operations and manufacturing processes. This can happen during the manufacture, usage, and disposal of plastics. Microplastic particles can be produced as byproducts of industrial processes such as plastic molding, machining, and cutting.
- The accumulation of wasted or abandoned plastic materials in the environment, particularly in natural ecosystems such as seas, rivers, and terrestrial habitats, is referred to as **plastic debris.** Plastic debris ranges in size from major things such as bottles and packaging to microscopic particles such as microplastics. Because of its permanence and negative effects on ecosystems, plastic waste offers considerable environmental issues. Millions of tons of plastic garbage are predicted to enter the environment each year. The accumulation of plastic debris is most visible in marine ecosystems, where it can have serious consequences for marine life, habitats, and food chains.

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Primary Microplastics

Microplastic fibres from clothing

Microbeads used in personal care products, such as facial scrubs, and in certain pharmaceutical products

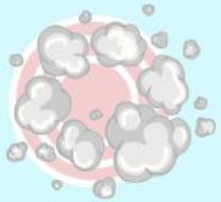
Plastic pellets used to clean industrial machinery through air blasting

Secondary Microplastics

Plastic litter, including plastic bags, bottles and packaging

Fragments from vehicle tyres, road surfaces and markings

Abrasion from shoe soles and artificial surfaces



Dust from urban areas

Secondary sources of microplastic pollution

- **Synthetic Fiber Shedding:** Synthetic textiles, such as polyester, nylon, and acrylic, shed microscopic threads after normal use and laundry. These microfibers are discharged into wastewater systems, where they eventually end up in rivers, lakes, and oceans. The shedding of synthetic fibers is regarded as a significant secondary source of microplastic contamination.
- **Tire Wear and Road Surface Degradation:** Vehicles with synthetic rubber tires emit microplastic particles through wear and tear. Small rubber particles are emitted into the environment as automobiles move over roads due to friction. Microplastics can be washed into bodies of water by stormwater runoff or become airborne particles.
- **Plastic Litter Degradation**: Plastic litter, which includes discarded plastic bags, packaging, and other single-use goods, can deteriorate over time as a result of sunlight and environmental conditions. Plastic degrades into microplastic particles, which can disseminate and contaminate marine environments.
- **Microbeads in Personal Care Products:** Microbeads, which are small plastic particles, are extensively utilized in personal care products such as face scrubs, body washes, and toothpaste. When these goods are washed and enter wastewater systems, the microbeads are not effectively filtered out and can end up in bodies of water, adding to microplastic contamination.

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- To address both primary and secondary sources of microplastic pollution, a multimodal approach is required. This includes minimizing single-use plastic manufacturing and consumption, improving waste management practices, establishing effective filtering systems, and promoting the use of alternative materials and sustainable product design. Furthermore, public awareness and education efforts are critical in preventing microplastics from entering the environment and promoting responsible consumption and disposal behaviors.

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Activity: Preliminary discussion

1. What are macroplastics, and how do they differ from microplastics in terms of their size, characteristics, and environmental impact?
2. What are some of the most common types of macroplastics found in marine and terrestrial environments?
3. Can you provide examples of common macroplastic items found in marine and terrestrial environments?
4. What are the primary sources of macroplastic pollution?
5. How do human activities and improper waste management contribute to the accumulation of macroplastics in different ecosystems, and what are some potential consequences of macroplastic pollution on wildlife and habitats?

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What are macroplastics?

Macroplastics are larger pieces of plastic and garbage that can be seen with the naked eye. They are distinguishable from microplastics, which are smaller plastic particles with a diameter of less than 5mm. Macroplastics are a broad category of plastic objects and materials that include bottles, bags, packaging, fishing gear, and other discarded plastic products.

- **Floating macroplastics** refer to plastic debris that remains buoyant and floats on the surface of water bodies, such as oceans, rivers, and lakes. These can include items like plastic bottles, caps, packaging, and larger fragments. Floating macroplastics are particularly concerning as they can be easily transported by wind and currents, contributing to the accumulation of plastic waste in marine environments.
- **Beached macroplastics** are plastic items that have washed up on beaches and been stranded along coasts. Larger items such as fishing nets, ropes, and plastic containers can fall into this category. Beached macroplastics pose various challenges as they not only create visual pollution but can also impact coastal ecosystems and wildlife. They often require manual removal efforts to mitigate their environmental impact.

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What are macroplastics?

- **Submerged macroplastics** refer to plastic debris that sinks below the water surface and becomes submerged in aquatic environments. These can include items like sunken boats, plastic waste that sinks due to its weight, or plastic materials that have become waterlogged. Submerged macroplastics are often found in riverbeds, lakes, and coastal areas. They can pose challenges for removal and may cause damage to underwater ecosystems.

Macroplastic litter legislation refers to laws and regulations aimed at tackling the problem of larger-scale plastic trash. hese regulations may encompass various aspects, including the prevention of plastic pollution, waste management practices, recycling requirements, and restrictions on the production and use of certain types of plastic products. Macroplastic litter legislation is critical in minimizing the effects of plastic pollution by encouraging responsible consumption, waste reduction, and correct disposal.

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Activity: Preliminary discussion

1. What are some commonly used techniques or methods for identifying microplastics in different environments?
2. Can you explain the principles behind these techniques and how they help in distinguishing microplastics from other particles?
3. Are there any emerging or advanced techniques being developed for microplastic identification?
4. How do these new techniques improve our ability to accurately detect and characterize microplastics in various environments?
5. What are the potential ecological and environmental impacts of microplastics on marine and terrestrial ecosystems? Can you provide examples?

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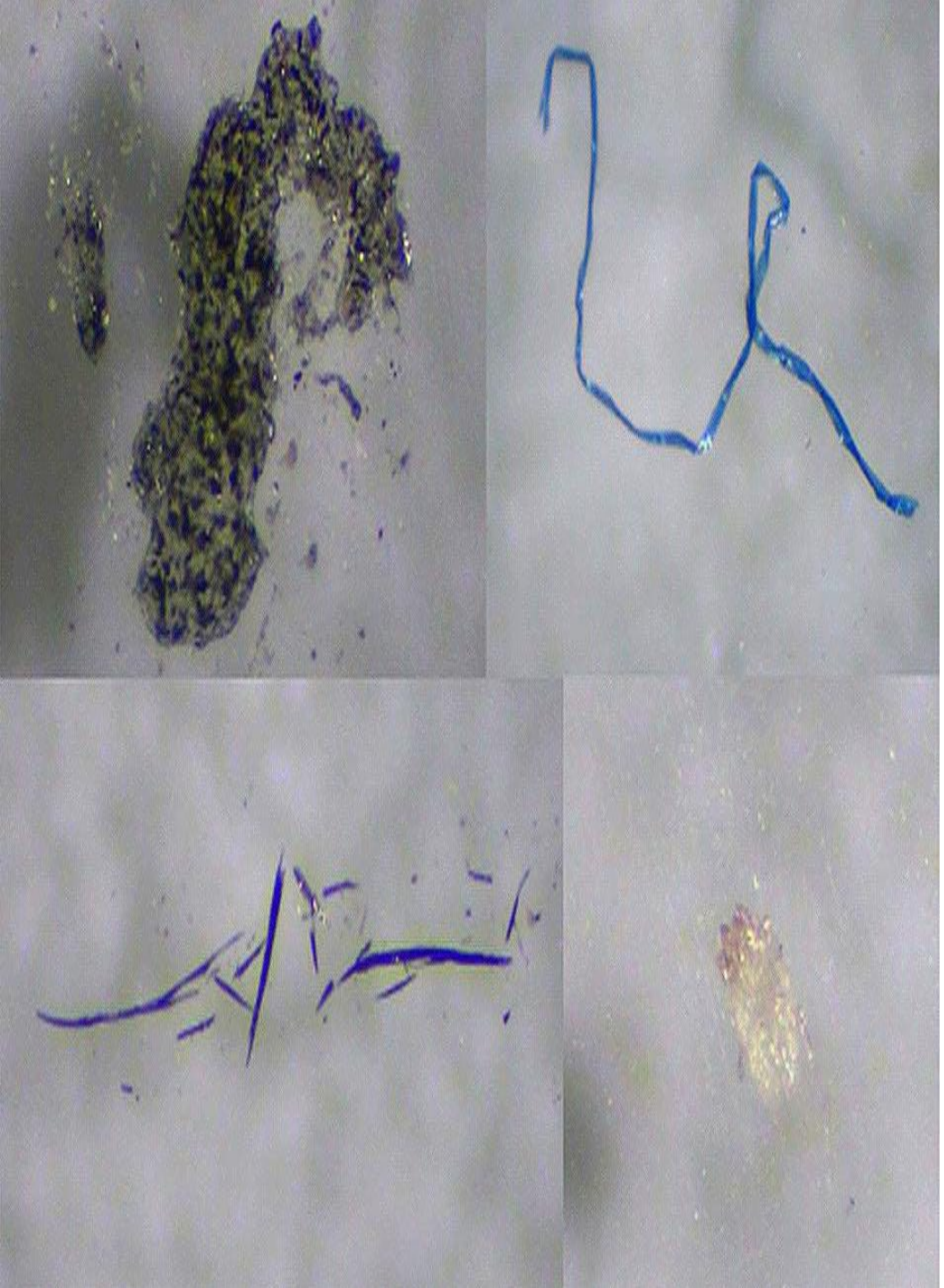

Microplastic identification techniques

To reliably detect and describe microplastic particles, microplastic identification techniques include a variety of procedures and devices. Here are several key techniques for identifying microplastics:

1) **Identification of Microplastics:** Microplastic identification begins with distinguishing plastic particles from other types of particles present in a sample. Visual inspection, chemical tests, and microscopic examination may be required.

2) **Sample Purification:** Before analysis, samples often undergo purification to remove organic and inorganic materials, ensuring that only microplastics are analyzed. Purification methods can include filtration, digestion, and density separation.

3) **Visual Identification** entails inspecting microplastics under a microscope to assess their shape, color, and size. Microplastics can take the form of fibers, pieces, spheres, or films.

4) **Standardized Size and Color Sorting (SCS) System** is a microplastic classification approach that employs uniform size and color codes. This approach allows for the constant categorization and comparison of microplastic samples across studies.

5) **Scanning Electron Microscope (SEM)** provides high-resolution imaging and detailed morphological analysis of microplastics. It uses an electron beam to scan the sample surface, generating magnified images that reveal microplastic characteristics.

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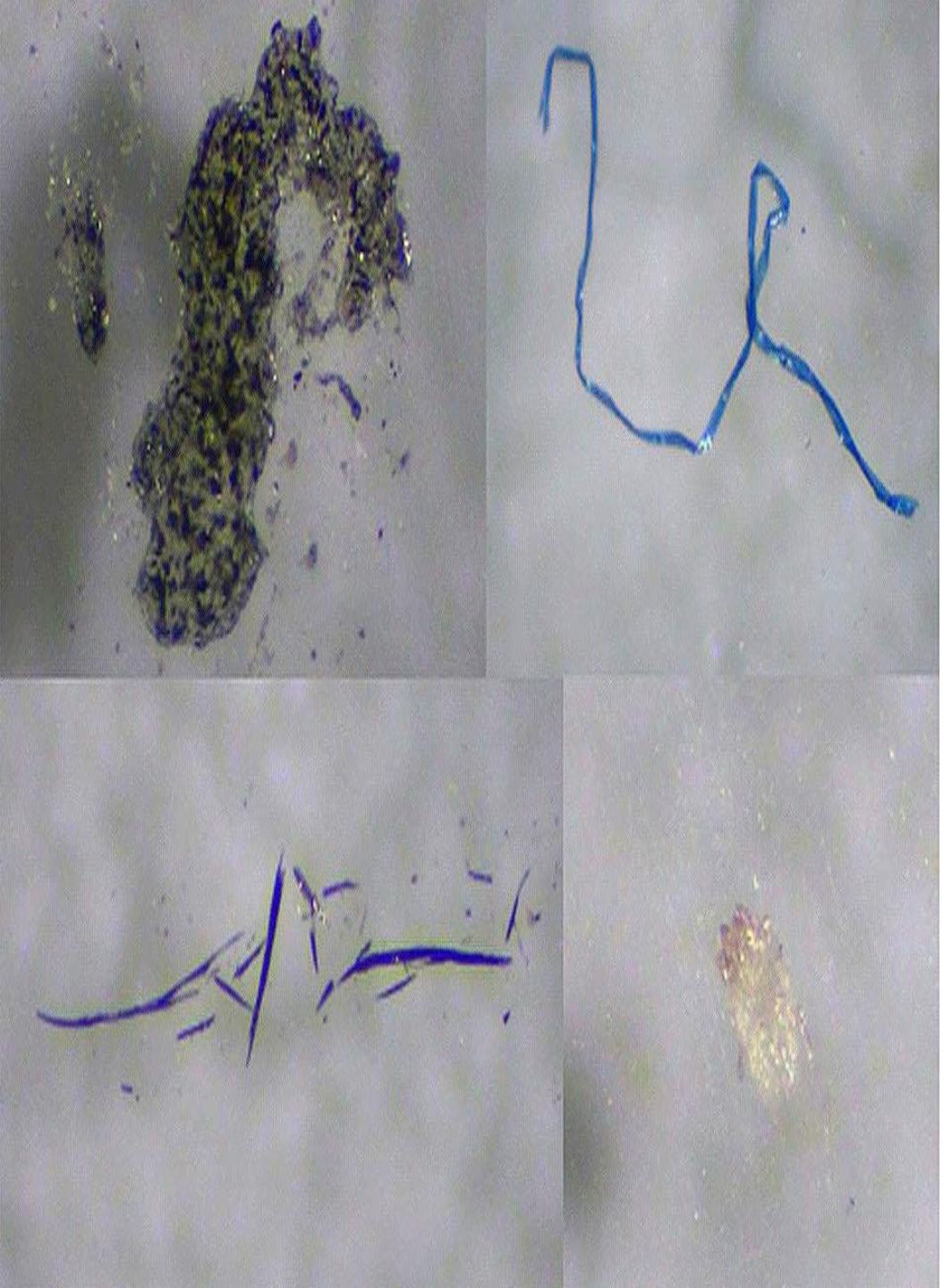

5) Nuclear Magnetic Resonance (NMR) Spectroscopy detects the unique chemical signatures of different plastic polymers. It can identify the type of plastic present in a sample by analyzing the specific resonances of hydrogen or carbon nuclei.

6) Fourier-Transform Infrared (FTIR) Spectroscopy studies infrared light absorption by molecules. FTIR can detect the presence of specific plastic polymers by comparing a sample's absorption patterns to reference spectra.

7) Near-Infrared (NIR) and Short-Wavelength Infrared (SWIR) Spectroscopy involve the analysis of infrared light reflection and absorption by materials. Based on their spectral characteristics, these approaches can distinguish between different types of polymers.

8) Raman Spectroscopy employs laser light to induce molecular vibrations in a material, resulting in a distinct scattering pattern. It may identify individual polymers by comparing the Raman spectra of plastics.

Microplastic identification techniques are critical for quantifying and characterizing microplastic pollution. They give useful data for study, monitoring, and assessment, allowing for a better knowledge of the distribution, sources, and effects of microplastics in the environment.

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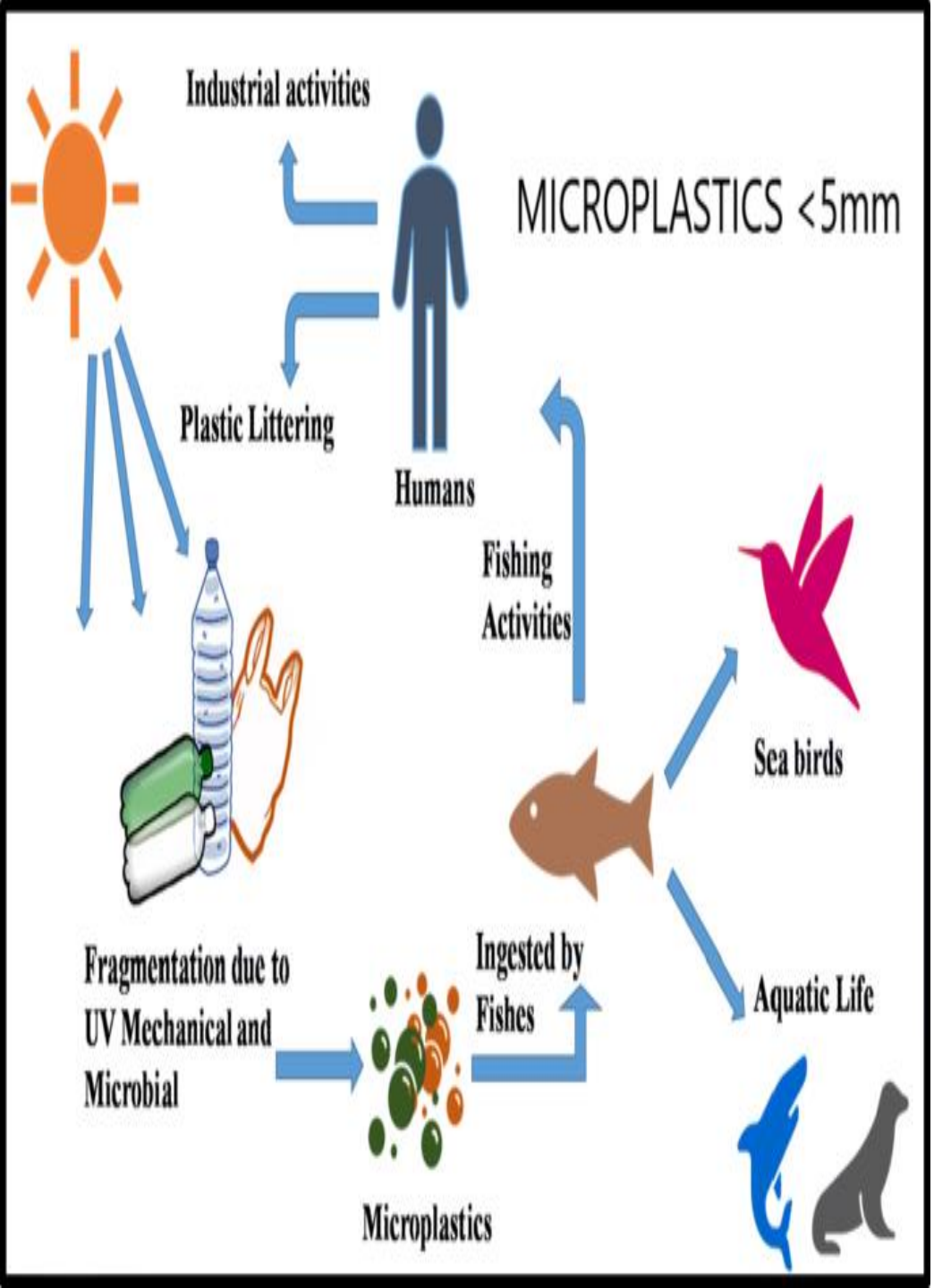

Impact of Microplastics

Microplastics have a significant impact on the environment, human health, economy, and regulatory frameworks. Understanding these effects is critical for creating effective microplastic pollution mitigation techniques and strategies. The following are the primary areas where microplastics have a substantial impact:

1) **Ecological Impacts of Microplastics on Marine Wildlife:** Microplastics represent serious ecological threats to marine wildlife. Aquatic organisms, including fish, invertebrates, seabirds, and marine mammals, can mistake microplastics for food and ingest them. This can lead to physical harm, internal injuries, reduced feeding efficiency, and even death. Microplastics can also accumulate in the tissues of organisms, potentially transferring toxic chemicals and disrupting physiological functions. Furthermore, microplastics can alter habitats and impact ecosystems by affecting nutrient cycling and altering microbial communities.

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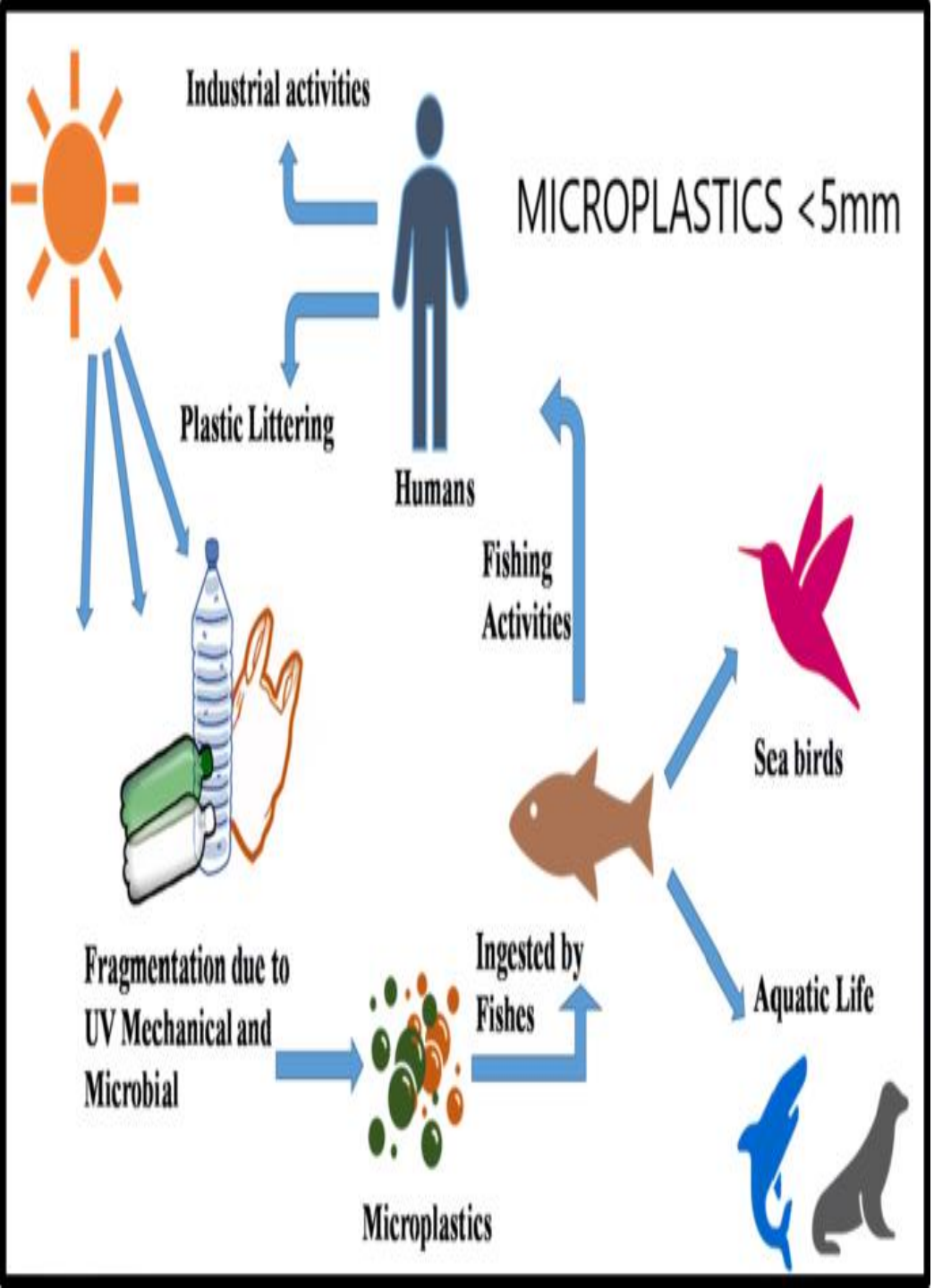

2) Health Impacts of Microplastics on Humans: While the full degree of microplastics' health impacts on humans is still being investigated, there are worries regarding potential hazards. Microplastics can enter the human body via contaminated seafood, inhalation of airborne particles, or even direct contact with consumer products. The presence of microplastics in the body raises concerns about the potential transfer of toxic chemicals associated with microplastics. However, more research is needed to understand the long-term health effects and the levels of exposure required for significant impacts.

3) Economic Impacts of Microplastics on Industries and Society: Microplastic pollution can have economic consequences for industries and society. For industries relying on clean and healthy ecosystems, such as fisheries, aquaculture, and tourism, the presence of microplastics can harm their operations and reputations. Microplastic contamination in seafood and agricultural products can lead to decreased consumer confidence, affecting market demand. Furthermore, the costs of microplastic cleanup, waste management, and research contribute to the economic burden.

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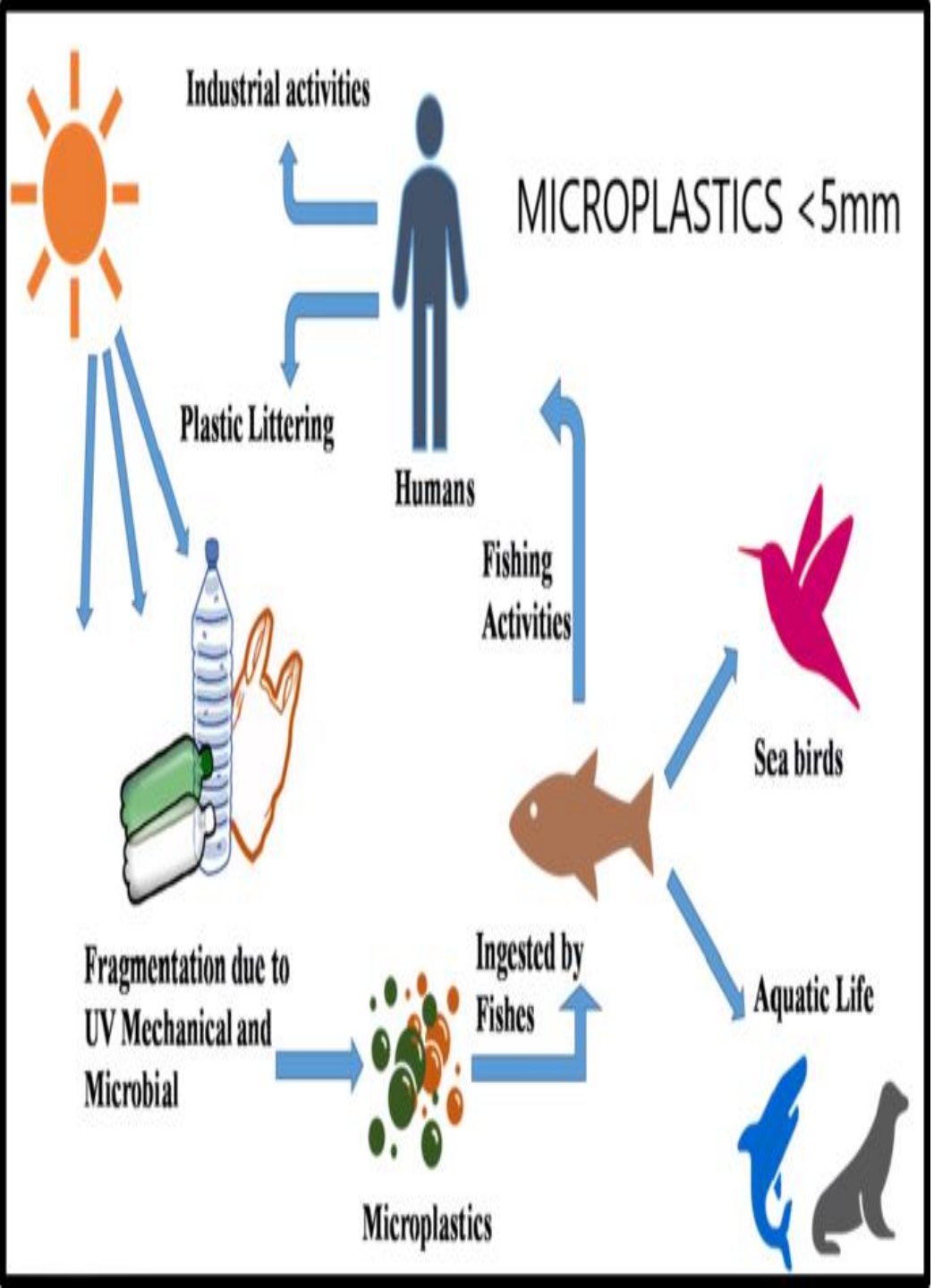

- **Risk Assessment and Regulation of Microplastics:**
- Understanding the risks posed by microplastics and implementing effective regulations are vital for managing and mitigating their impacts. Risk evaluations aid in the identification of microplastic pollution's sources, pathways, and potential impacts. By addressing primary and secondary sources, creating waste management procedures, and promoting sustainable alternatives, regulatory frameworks and recommendations can help minimize microplastic contamination. International, national, and regional initiatives are underway to develop policies and standards to regulate microplastics and reduce their environmental impact. To address the effects of microplastics, multidisciplinary activities such as research, education, innovative technology, and policy interventions are required. It is feasible to reduce the ecological, health, and economic implications of microplastic pollution and protect the well-being of both the environment and society through raising awareness, supporting sustainable practices, and enacting appropriate legislation.

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ACTIVITIES

ACTIVITY 1

SORT OUT THE RUBBISH

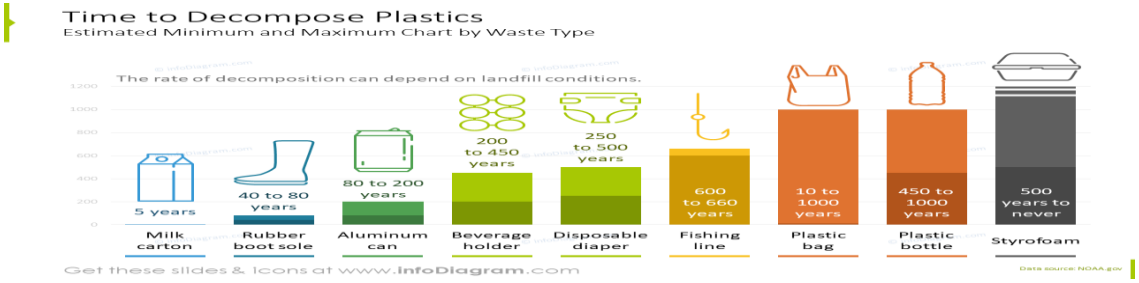
STUDENTS WILL DISCUSS WHAT CAN AND CANNOT BE RECYCLED IN GROUPS OF FOUR OR FIVE. COLLECT A VARIETY OF GOODS THAT PEOPLE WOULD THROW OUT, BOTH RECYCLABLE AND NON-RECYCLABLE (ENOUGH FOR EACH GROUP TO HAVE AT LEAST 5-10 ITEMS, AND THE INSTRUCTOR MAY ALSO ENCOURAGE STUDENTS TO BRING ITEMS).

THEN THE INSTRUCTOR WILL FURTHER ENCOURAGE STUDENTS WORK IN SMALL GROUPS AND SORT ITEMS INTO WHAT CAN BE RECYCLED AND WHAT CANNOT. LATER WILL ASK THEM TO DISCUSS WHAT THEY NOTICE AND WHAT THEY DO AND DO NOT KNOW ABOUT RECYCLING AS THEY GO ALONG. AFTER THEY HAVE SORTED THE ITEMS, INSTRUCTOR GIVES THEM A HINT OR A LINK SHOWING WHAT CAN AND CANNOT BE RECYCLED IN GENERAL. LATER WILL ASK THEM TO CHECK AND RE-SORT ANYTHING AS NECESSARY.

THEN, THE CLASS WILL DISCUSS WHAT THEY DISCOVERED:
1) WHAT SURPRISED YOU?
2) DID YOU BELIEVE THAT MORE GOODS COULD BE RECYCLED THAN ARE CURRENTLY ACCEPTED?
3) HAVE YOU ATTEMPTED TO RECYCLE PRODUCTS THAT CANNOT BE RECYCLED?
4) WHAT HAPPENS WITH THE REST OF THIS? DID YOU KNOW THERE IS SO MUCH WASTE THAT CANNOT BE RECYCLED?
5) HAT ARE YOUR OPTIONS? HOW COULD YOU LESSEN THE AMOUNT OF WASTE YOU PRODUCE? BRAINSTORM AND LIST IDEAS: FIRST INDIVIDUALLY, THEN THE WHOLE CLASS.

ACTIVITY 2
CREATE A DECOMPOSITION TIMELINE

STUDENTS WILL LEARN ABOUT LITTER AND MARINE DEBRIS, AND HOW IT CAN PERSIST IN THE ENVIRONMENT.
THEY WILL WORK TOGETHER TO PLACE LITTER ITEMS ALONG A TIMELINE TO VISUALLY SHOW HOW LONG IT
TAKES FOR DIFFERENT ITEMS TO DECOMPOSE, SIMILAR TO THE TIMELINE BELOW.



STEPS

1. TO ILLUSTRATE 600 YEARS OF DECOMPOSITION TIME, USE STRING OR A WHITEBOARD.
2. ATTACH SIX DIFFERENT TIME PERIODS TO THE ROPE OR SKETCH THEM ON THE WHITEBOARD.
3. DIVIDE THE STUDENTS INTO GROUPS AND GIVE EACH GROUP A LITTER ITEM OR A PICTURE. ALLOW THEM TO
4. DISCUSS THEIR ITEM AND PLACE IT NEXT TO THE PREDICTED DECOMPOSITION TIME.
5. READ OUT THE CORRECT DECOMPOSITION TIMES TO TEAMS AND HAVE THEM MODIFY THEIR POSITIONS AS NEEDED.
IT SHOULD BE NOTED THAT DECOMPOSITION TIMES ARE ESTIMATIONS THAT CAN VARY DEPENDING ON ENVIRONMENTAL CIRCUMSTANCES.

ACTIVITY 3

MICROPLASTICS HUNT

THE INSTRUCTR WILL GIVE STUDENTS A LIST OF FREQUENT MICROPLASTIC ITEMS AND INVITE THEM TO LOOK FOR THEM IN THE CLASSROOM OR OUTSIDE. ONCE DISCOVERED, STUDENTS CAN DISCUSS PROBABLE CAUSES, CONSEQUENCES, AND SOLUTIONS TO LIMIT THEIR CONSUMPTION.

ACTIVITY 4
MICROPLASTICS SIMULATION

INSTRUCTOR CAN CREATE A HANDS-ON EXERCISE IN WHICH STUDENTS IMITATE THE SPREAD OF MICROPLASTICS IN MARINE ENVIRONMENT. TO SYMBOLIZE MICROPLASTICS, THE TEAHCER CAN USE GLITTER OR SMALL PLASTIC PARTICLES AND INVITE STUDENTS TO OBSERVE HOW QUICKLY THEY DISPERSE AND THEIR POSSIBLE INFLUENCE ON MARINE LIFE.

ACTIVITY 5

MICROPLASTICS RESEARCH DISCUSSION: INSTRUCTOR WILL ASSIGN VARIOUS SORTS OF MICROPLASTICS RESEARCH PAPERS OR ARTICLES TO STUDENTS TO READ AND SUMMARIZE THEN CAN FACILITATE A DISCUSSION IN SMALL GROUPS OR THE WHOLE CLASS ABOUT THE IMPORTANT FINDINGS, METHODOLOGY EMPLOYED, AND IMPLICATIONS OF THE RESEARCH ON MICROPLASTICS POLLUTION IN MARITIME ECOSYSTEMS.

MICROPLASTICS AWARENESS CAMPAIGN: INSTRUCTOR WILL DIVIDE STUDENTS INTO GROUPS AND ASSIGN MOST WELL-INFORMED STUDENTS TO CONSTRUCT BRIEF AWARENESS CAMPAIGNS TO EDUCATE THEIR CLASSMATES ABOUT THE PROBLEM OF MICROPLASTICS IN MARITIME ECOSYSTEMS. DESIGNING POSTERS, CREATING SOCIAL MEDIA POSTS, OR MAKING SMALL PRESENTATIONS TO CONVEY CRUCIAL MESSAGES REGARDING MICROPLASTICS CONTAMINATION ARE ALL EXAMPLES OF THIS.

MICROPLASTICS REMOVAL BRAINSTORMING: INSTRUCTOR WILL HOLD A BRAINSTORMING SESSION WITH KIDS TO CREATE IDEAS FOR INNOVATIVE SOLUTIONS TO MICROPLASTICS CONTAMINATION IN MARITIME AREAS. ENCOURAGE THEM TO THINK CREATIVELY AND EXAMINE TECHNOLOGICAL, EDUCATIONAL, OR OTHER OPPORTUNITIES.

ACTIVITY 6

MICROPLASTICS DATA ANALYSIS: INSTRUCTOR WILL GIVE STUDENTS REAL OR SIMULATED DATA SETS ABOUT MICROPLASTIC POLLUTION IN CERTAIN MARINE AREAS. THEN WILL GUIDE THEM THROUGH THE PROCESS OF ASSESSING THE DATA, DETECTING TRENDS OR PATTERNS, AND REACHING JUDGMENTS REGARDING THE DEGREE OF MICROPLASTIC CONTAMINATION.

MICROPLASTICS DEBATE: TEACHER CAN DIVIDE THE CLASS INTO TWO GROUPS AND ASSIGN OPPOSING PERSPECTIVES ON MICROPLASTICS CONTAMINATION TO EACH GROUP. LATER CAN CONDUCT A SYSTEMATIC DEBATE IN WHICH STUDENTS WILL GIVE ARGUMENTS AND COUNTERARGUMENTS, BACKED UP BY FACTS AND SCIENTIFIC RESEARCH.

REFLECTION ON THE IMPACT OF MICROPLASTICS ON MARINE ENVIRONMENTS: INSTRUCTOR CAN HAVE STUDENTS WRITE A BRIEF ESSAY ABOUT THEIR PERSONAL THOUGHTS AND EMOTIONS ABOUT THE IMPACT OF MICROPLASTICS ON MARINE ENVIRONMENTS. THEN ENCOURAGE CHILDREN TO THINK ABOUT THE POSSIBLE IMPLICATIONS AND THEIR PART IN REDUCING MICROPLASTIC CONTAMINATION.

ACTIVITY 6

MICROPLASTICS CASE STUDIES: GIVE STUDENTS CASE STUDIES OF DISTINCT MARINE AREAS THAT HAVE BEEN SUBSTANTIALLY IMPACTED BY MICROPLASTIC POLLUTION. ASK STUDENTS TO INVESTIGATE THE CASE STUDY IN SMALL GROUPS, IDENTIFY THE KEY SOURCES, AND RECOMMEND POTENTIAL MITIGATION SOLUTIONS CUSTOMIZED TO THE SPECIFIC CIRCUMSTANCES.

MICROPLASTICS QUIZ OR KAHOOT GAME: USING ONLINE PLATFORMS LIKE KAHOOT, INSTRUCTOR CAN CREATE A FUN QUIZ OR INTERACTIVE GAME TO ASSESS STUDENTS' UNDERSTANDING ABOUT MICROPLASTICS IN MARITIME ENVIRONMENTS. INCLUDE INQUIRIES ABOUT THE CAUSES, CONSEQUENCES, IDENTIFYING METHODS, AND PROPOSED SOLUTIONS.

THE ABOVE DESCRIBED ACTIVITIES WILL ALLOW STUDENTS TO ACTIVELY LEARN ABOUT MICROPLASTICS IN MARITIME ECOSYSTEMS WHILE ALSO ENCOURAGING CRITICAL THINKING, TEAMWORK, AND AWARENESS OF THE ISSUE.

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CONSORTIUM

CETMAR
CENTRO TECNOLÓGICO DEL MAR

INOVA+
INNOVATION
FOR GROWTH

BBZ am Nord-Ostsee-Kanal
Europaschule

LJA

EMA
ESCOLA DO MAR . AÇORES

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Thank you!

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Charge: Project Manager
Company: INOVA+

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greedivingeuropeanproject

Green Diving

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Unit 6:

Waste management at different workshops

Enhancing green skills, sustainability, and attractiveness of Maritime VET

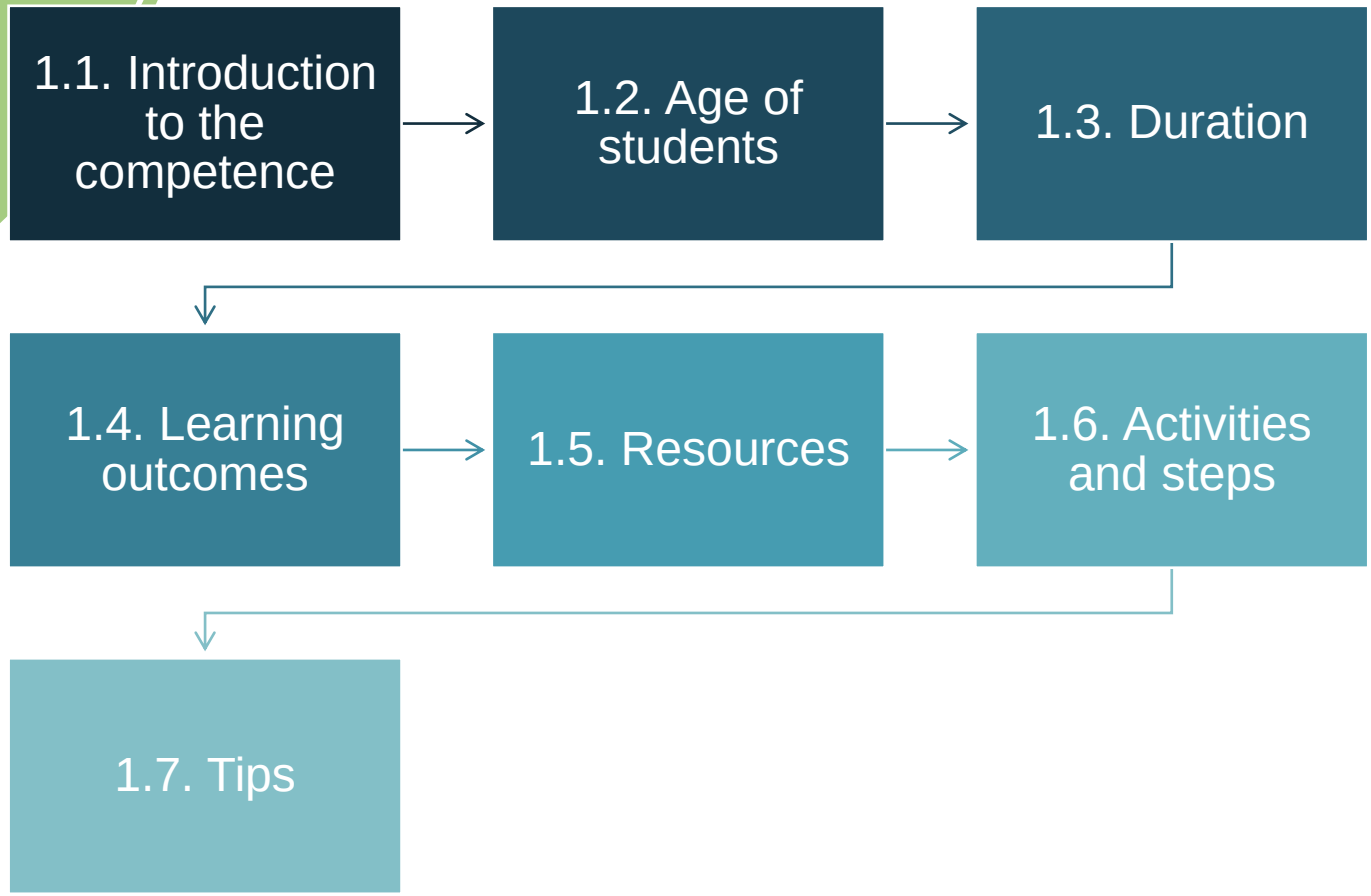
Funded by the European Union

1.4. Learning outcomes of this PPT

1. You will get new **theoretical and practical materials on sustainable waste managemen**t that you can use with your students.
2. You will **see how other teachers have introduced the subject of waste management in their classrooms**.
3. You will have a greater number of **ideas** and useful educational resources for your activity as a teacher.

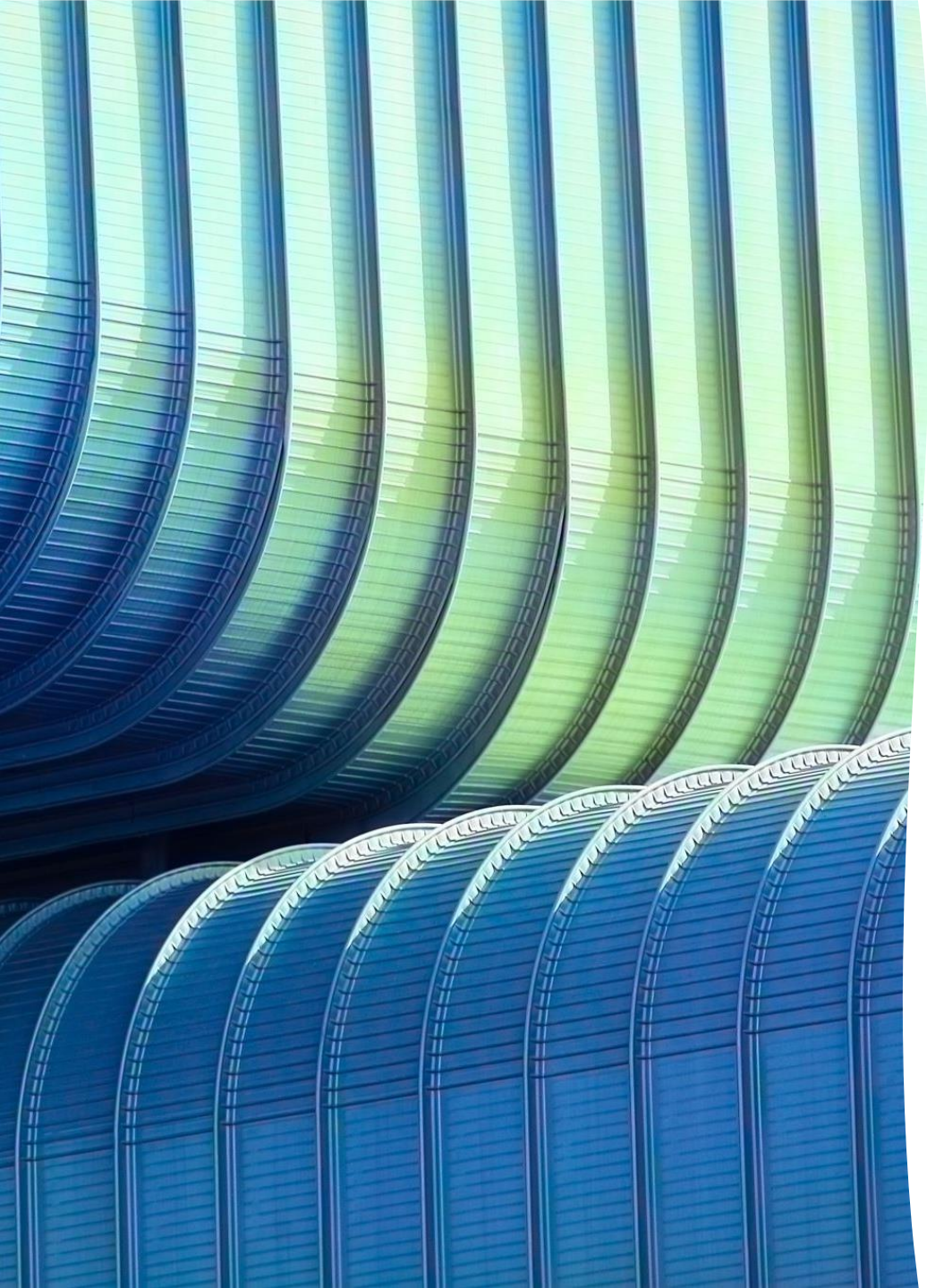
Index

1. The class plan:



1.1. Introduction to the competence

Briefly description of the contents.



1.1. Introduction to the competence

In the class we do a revision of all this theory contents:

- What is waste?
- What is waste management?
- Different types of waste in general
- Hazardous waste
- Waste generated in the workshop
- Waste Management in our center

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Erasmus+ Programme
of the European Union

1. Where?

Pilot carried out in:

“A Aixola” Training centre

aixola.cetmar.org

A AIXOLA
CENTRO DE FORMACIÓN
MARÍN

The centre offers courses in the areas of **wood boat-building, composites, electrical and mechanical engineering, sails and nets construction.**

Pilot in all the courses

What we pilot?

Unit 6: WASTE MANAGMENT

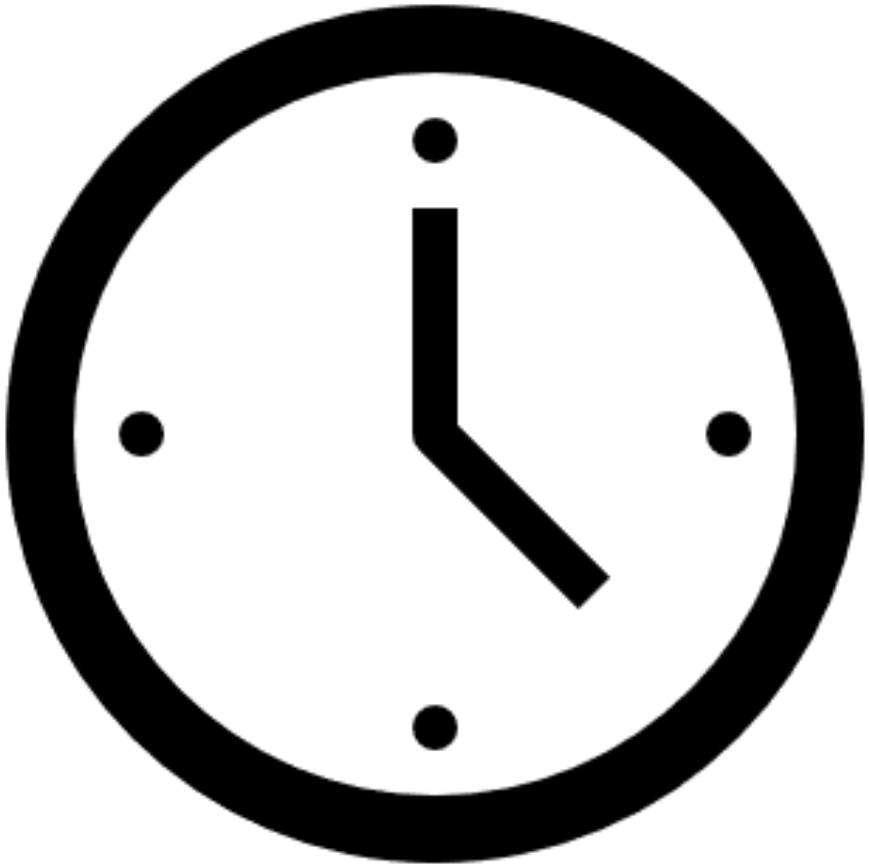
Split on:

- Waste management on a composites workshop.
- Waste management on sail workshop.
- Waste management electrical and mechanical engineering workshop.
- Waste management on wood boat-building workshop.
- Waste management on nets construction workshop.

1.2. Age of students

1.2. Age of students

- The contents are valid for adults' students in general.
- In our pilot experience, we had students from 18 to 65 years old.



1.3. Duration: 3 HOURS

1.6. Activities

1.6. Activity 1

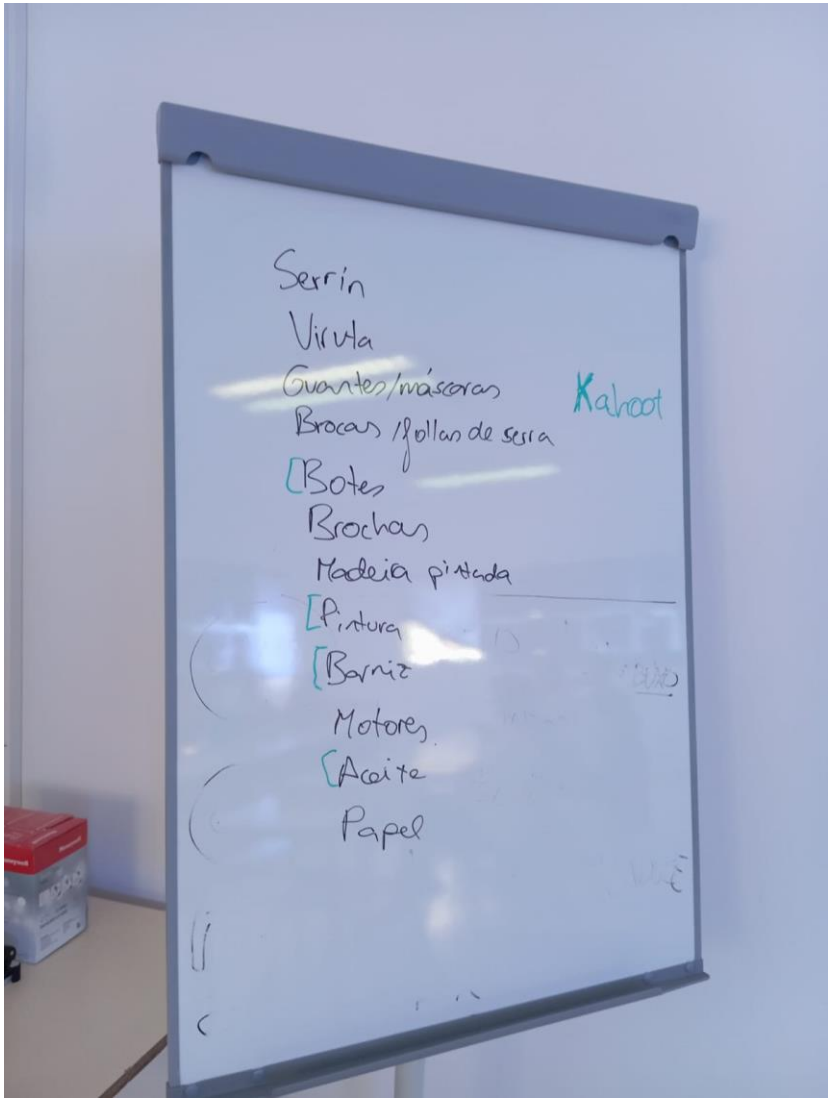
“Looking for My place”

The first step is to prepare a collaborative list of all the waste generated in the workshop.

Then create some stickers with the different types of waste identified and classify the waste into categories: hazard or not hazard. The ones that have a hazard should be red.

Divide the stickers among the students and place them in the workshop. Where? In the location where the waste should be deposited.

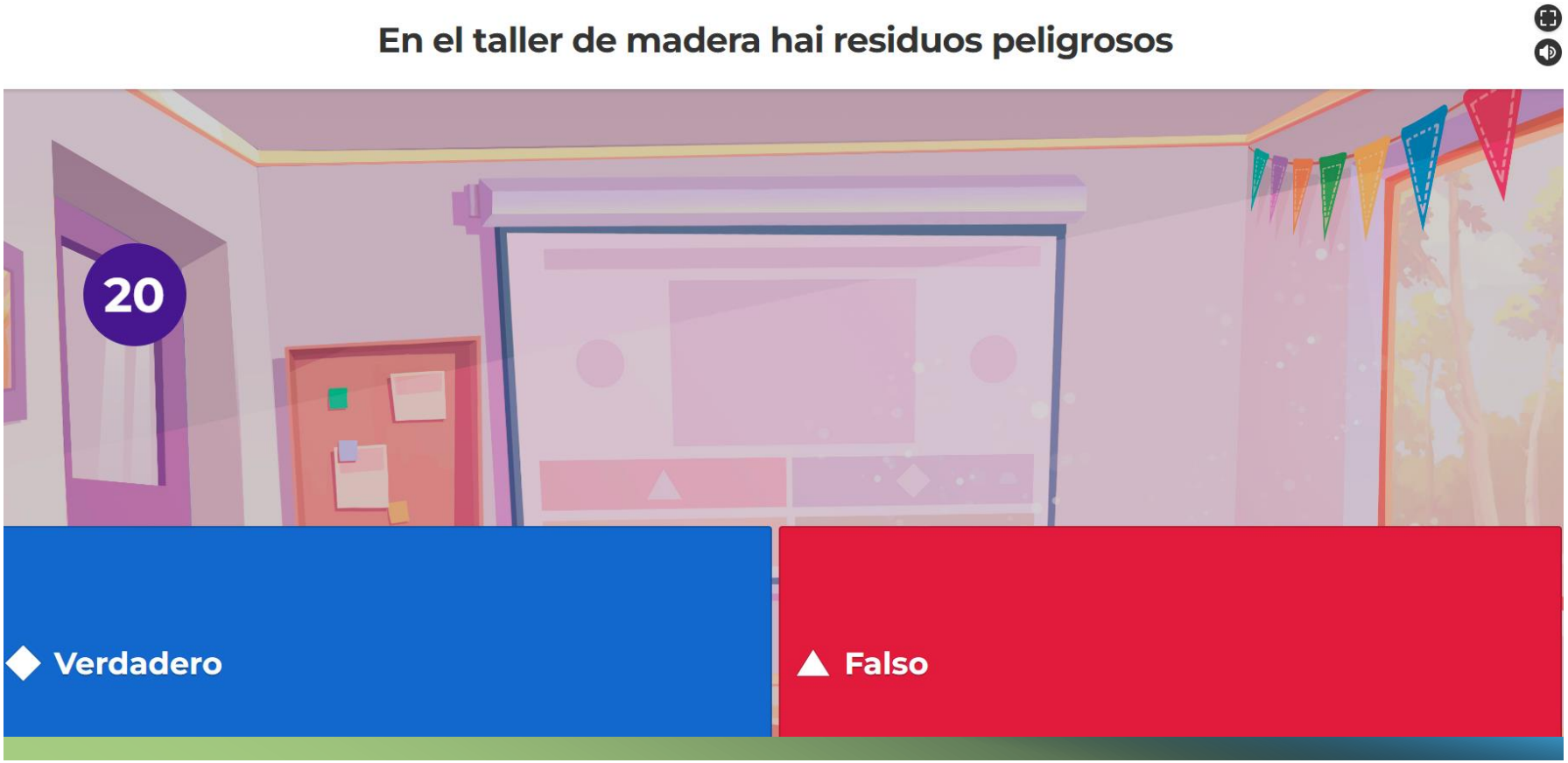
The stickers will remain in the workshop so that no one forgets where to sort through the trash.



Example of the list we create on the wood workshop:

1.6. Activity 2

Try to guess the meaning of the pictograms game



Activity 3 (wood workshop)

Kahoot

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Activity 3 (wood workshop)

Kahoot

¿Qué productos se pueden obtener del reciclaje de residuos de ma

1.5. Learning resources

1.5. Learning resources

1. A power Point presentation about waste management created in this project.
2. YouTube videos:

- How it’s made: wood pellets?w it’s made: wood pellets?

3. Webs:

- Waste statistics Europe
- Summary of the current EU waste legislation
- Definitions
- Waste framework directive
- European List of Waste
- Guideline to classify waste
- Bridging education and business in the blue economy: best practices and user stories.
- Particleboard from agricultural biomass and recycled wood waste: a review

1.6. Activity 3

Extra activity

In these workshops in which the amount of waste is very low, we can do this extra activity like the **kahoot**.

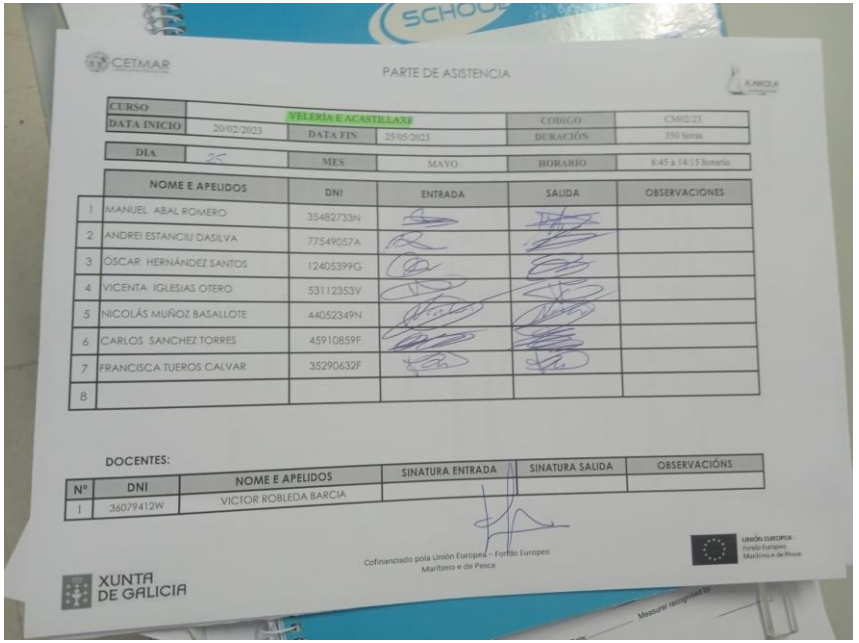
Which consists of the search of a local **waste treatment plant to** prepare its **flow diagram** and understand the procedure for treating urban waste, which in turn is also generated in the industrial sector. In our case, we proposed the elaboration of the treatment flow diagram of a plastics treatment plant called SOGAMA and that of a general waste plant.

2. Presentation of main result of the pilot experience.

Pilot steps:

The septs of the session:

1. We start by doing a **theory introduction to the classification of waste** (using PPW presentation).
2. Then we create a **list of the waste they produce.**
3. We did in collaboration a **classification** of the identified waste.
4. We described the **management** of each type of waste and found improvements in the process.



CETMAR

PARTE DE ASISTENCIA

CURSO	VELERÍA E ACASTILLAXE		CODIGO	CM02/23
DATA INICIO	20/02/2023	DATA FIN	25/05/2023	DURACIÓN	350 horas
DIA	25	MES	MAYO	HORARIO	8:45 a 14:15 horario

	NOME E APELIDOS	DNI	ENTRADA	SALIDA	OBSERVACIONES
1	MANUEL ABAL ROMERO	35482733N			
2	ANDREI ESTANCIU DASILVA	77549057A			
3	ÓSCAR HERNÁNDEZ SANTOS	12405399G			
4	VICENTA IGLESIAS OTERO	53112353V			
5	NICOLÁS MUÑOZ BASALLOTE	44052349N			
6	CARLOS SANCHEZ TORRES	45910859F			
7	FRANCISCA TUEROS CALVAR	35290632F			
8					

DOCENTES:

Nº	DNI	NOME E APELIDOS	SINATURA ENTRADA	SINATURA SALIDA	OBSERVACIÓNS
1	36079412W	VICTOR ROBLEDA BARCIA			

Cofinanciado pola Unión Europea – Fondo Europeo Marítimo e de Pesca

XUNTA DE GALICIA

List of students

Questionnaires: Main results on the pilots: composites

Questions:	Students' opinion (out of 5)
Importance of the topic: waste management on the industry	4
Interest of the contents	4.6
Contribution to the sustainability on the industrial sector	4.6
Usefulness of the session to raise awareness	**4.8**
Methodology	4.6
Do you think that the session is useful for your future job performance?	4.2

Main results on the pilots: sails

Questions:	Students' opinion (out of 5)
Importance of the topic: waste management on the industry	**4.85**
Interest of the contents	4.28
Contribution to the sustainability on the industrial sector	4.14
Usefulness of the session to raise awareness	3.42
Methodology	4.42
Do you think that the session is useful for your future job performance?	3.7

Main results on the pilots: electrical and mechanical engineering

Questions:	Students' opinion (out of 5)
Importance of the topic: waste management on the industry	4
Interest of the contents	4.6
Contribution to the sustainability on the industrial sector	4.6
Usefulness of the session to raise awareness	**4.8**
Methodology	4.6
Do you think that the session is useful for your future job performance?	4.2

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Thank you!

Gloria Mallou Tato

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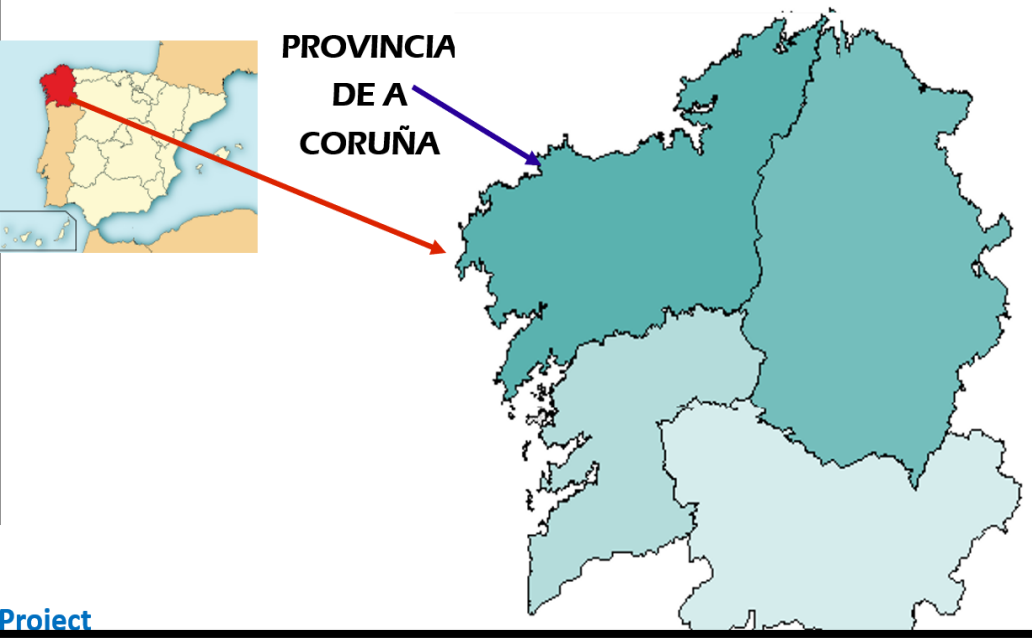
Green Diving Project

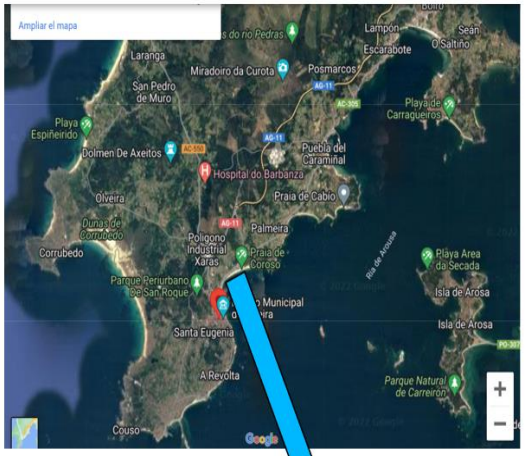
UD4_1: RAISING AWARENESS MICROPLASTICS.

Funded by the European Union

LOCATION. PROVINCE OF A CORUÑA.



Project



C I FP
C.I.F.P. COROSO

WHERE?

Project carried out in:

"CIFP COROSO" Training centre

cifp.coroso@edu.xunta.gal

The centre offers courses in the areas of **Maintenance of sports vessels.**

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INDEX OF THE COURSE

Learning objectives.

- What are micro plastics?.
  - Provenance.
  - Effects on health.
- Raise awareness of the damage that micro plastics can cause in the marine environment.
- Locate and identify micro plastics in their different forms and in the different media in which they can be found.
  - Assembly a paper microscope.
  - Identification of micro plastics

Results of the Green Diving project

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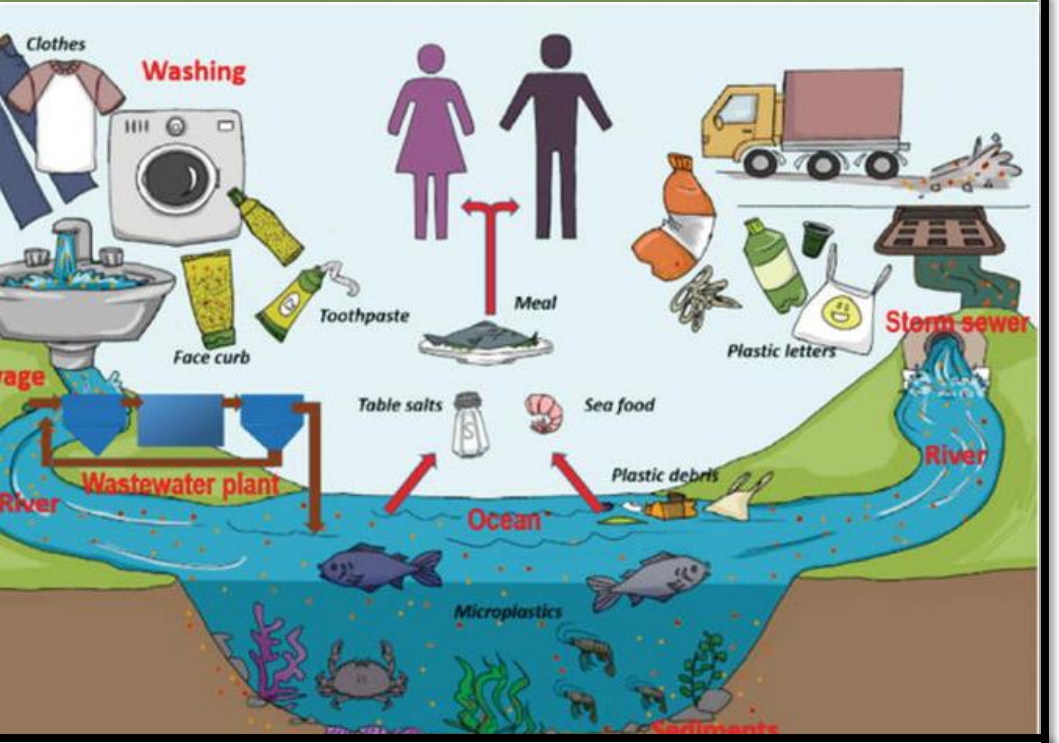

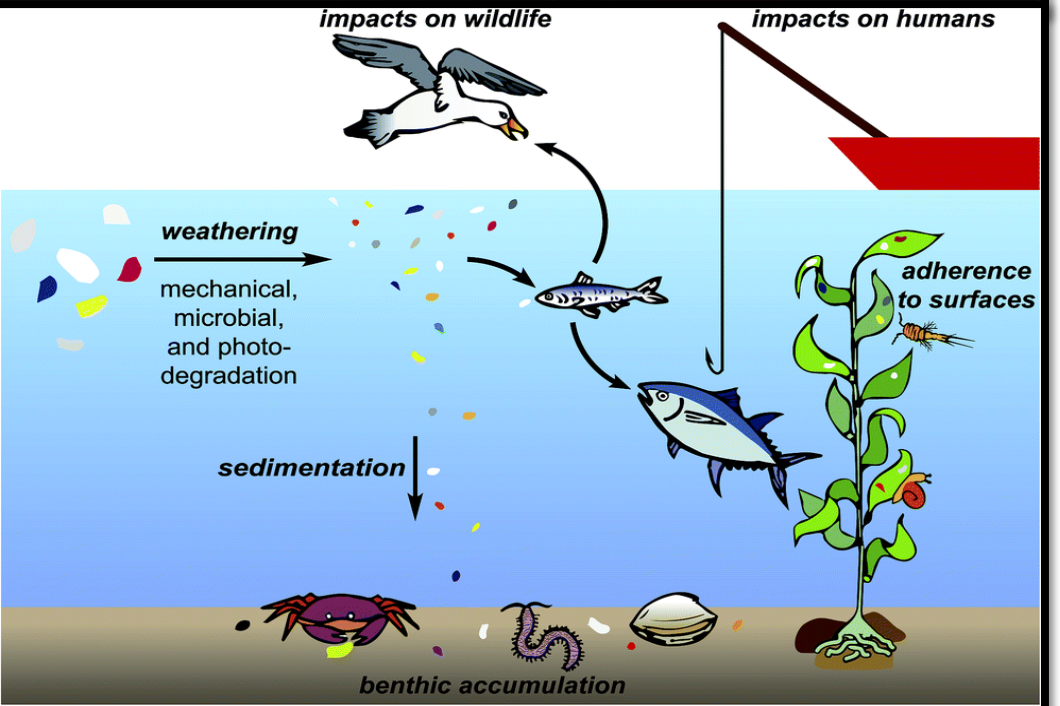

LEARNING OBJECTIVES

- **What are micro plastics?.**
  - Provenance.
  - Effects on health.
- **Raise awareness of the damage** that microplastics can cause in the marine environment.
- **Locate and identify microplastics** in their different shapes and in the different media in which they can be found.
  - Assembly a paper microscope.
  - Identification of micro plastics
    - Shapes of micro plastics in the sea.
    - Micro plastics through the microscope.

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¿What are micro plastics?

Meeting and colloquium with 2nd year boat maintenance students about what micro plastics are. **9 students**

These are the answers given by the students:

- Small pieces of plastic.
- They take a long time to get rid of.
- Some are not visible to the naked eye.
- They come from containers, nets, ropes, etc.
- They are very polluting.
- They can even kill animals and cause serious health damage.

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Awareness of the damage micro plastics can cause

Colloquium with 2nd year boat maintenance students about the effects on health. (9 students)

Conclusions provided by students and teachers.

- Microplastics are found in many different places: sea water, salt, honey, sugar, human feces, fish, shellfish, food, and even in the air.
- They are very polluting.
- The health concern is not due to the plastic particles, which are eliminated through dregs, but to the chemical additives and pollutants that can be released.

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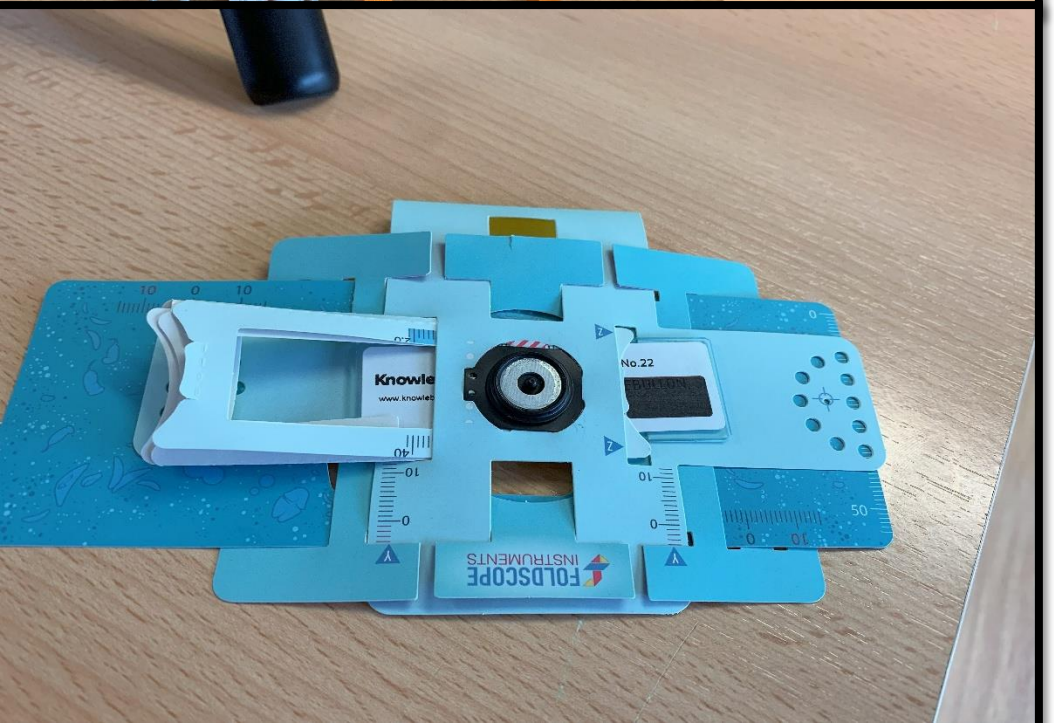

LOCATE AND IDENTIFY MICRO PLASTICS

Students carry out this practical activity in order to identify micro plastics in different media (sea water, area, exfoliating cream and in the intestines of fish).

They start by assembling a Foldscope paper microscope.

- Activity guided by a teacher in which they participate with motivation and interest.
- Everyone sets up their paper microscope.
- *"The Foldscope is a folding paper microscope that costs less than a dollar to make, but is durable and extraordinarily useful, according to inventor Manu Prakash of Stanford University."*

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LOCATE AND IDENTIFY MICRO PLASTICS

Once the Foldscope paper microscope is assembled, they perform different visualizations.

- The microscope can magnify objects up to 2000 times their actual size.
- The students carry out the activity with interest and are very motivated asking to repeat the experience.

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LOCATE AND IDENTIFY MICRO PLASTICS

They learn to identify the most common forms in which microplastics can be found in the ocean.

With the collaboration of the teaching staff and consulting on the internet, they reach the following conclusions. They decide which images and definitions are the most representative.

- **Fibers**: They look like brightly colored threads.
- **Fragments**: with irregular size and edges, in colors from white to striking blues and yellows.

FIBRAS

FRAGMENTOS

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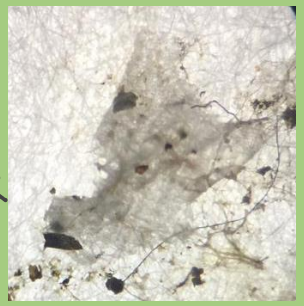
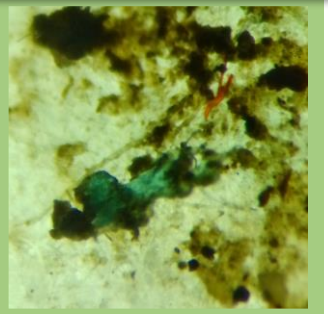
LOCATE AND IDENTIFY MICRO PLASTICS

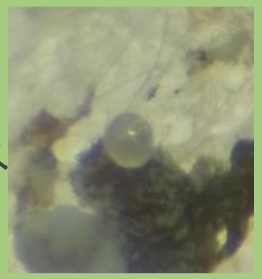
- **Film**: very thin and stretchy, mostly clear.
- **Sphere**: spherical particles, white, transparent or cream.
- Fragments predominate in water due to their buoyancy, followed by fibers, films and finally, less abundant, spheres.

FILMS





ESFERAS



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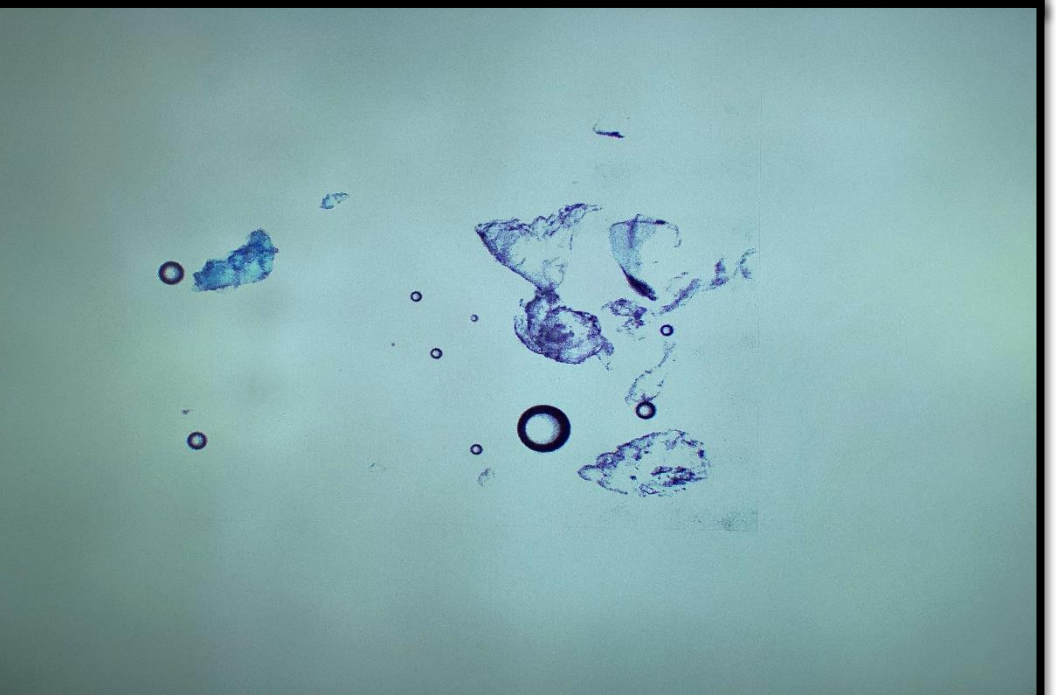

LOCATE AND IDENTIFY MICRO PLASTICS

With the help of microscopes, they identify micro plastics from a sample of sea water, sand, from an exfoliating cream, and in the intestines of a fish.

- **Sea water**: the students appreciate the microplastics in the forms of film and spheres and fibers described in the previous sections.

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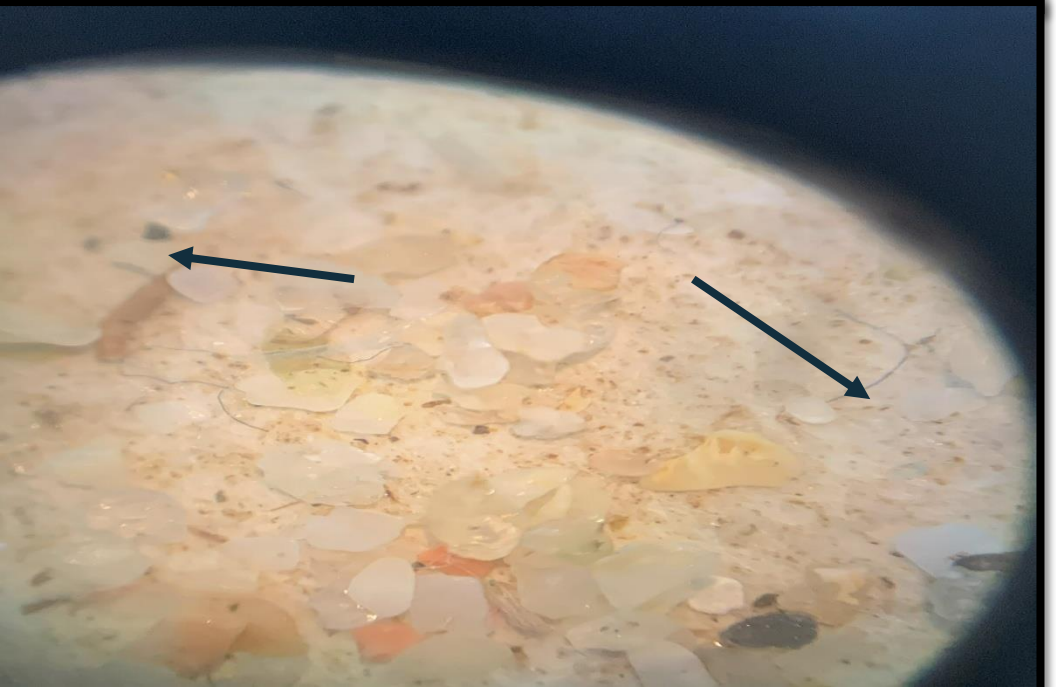

LOCATE AND IDENTIFY MICRO PLASTICS

- **Sand:** the grains of silica and quartz that make up the sand and small fragments of plastic in the form of fibers and fragments indicated by arrows in the image are perfectly appreciated.

The students participate actively, they were responsible for locating the micro plastics in the sample.

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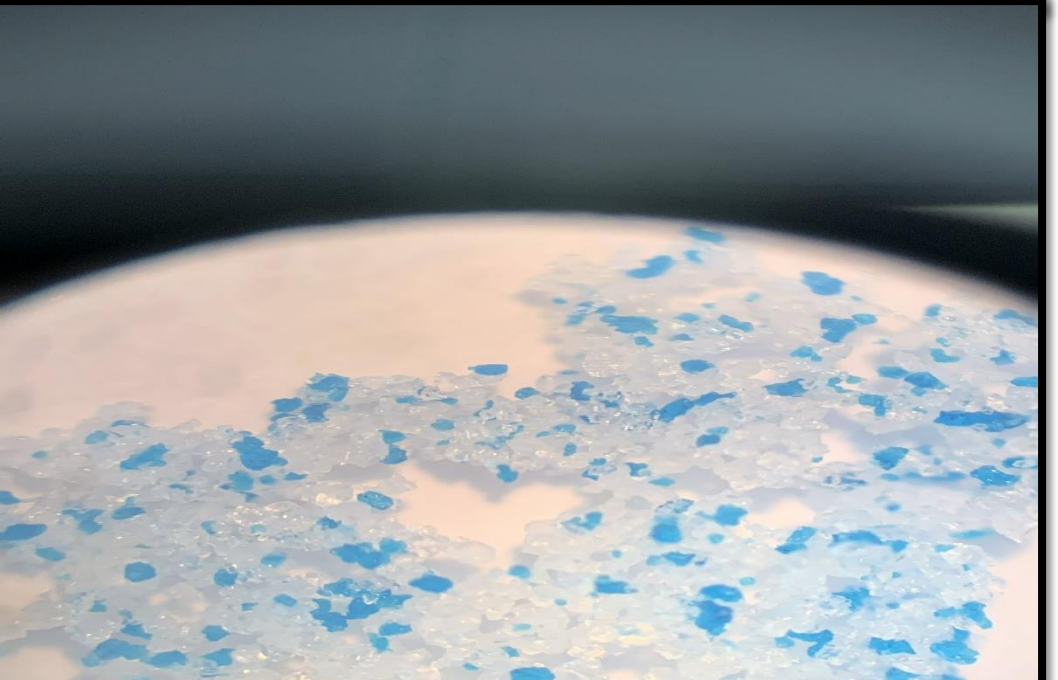

LOCATE AND IDENTIFY MICRO PLASTICS

- **Exfoliating cream:** the small plastic fragments present in the cream whose function is to remove dead skin cells are perfectly appreciated.
- The students are in disbelief that they never thought that a cream could carry pieces of plastic.
- These creams reach the sea when they are removed from our bodies through showers, swim at the beach, etc.

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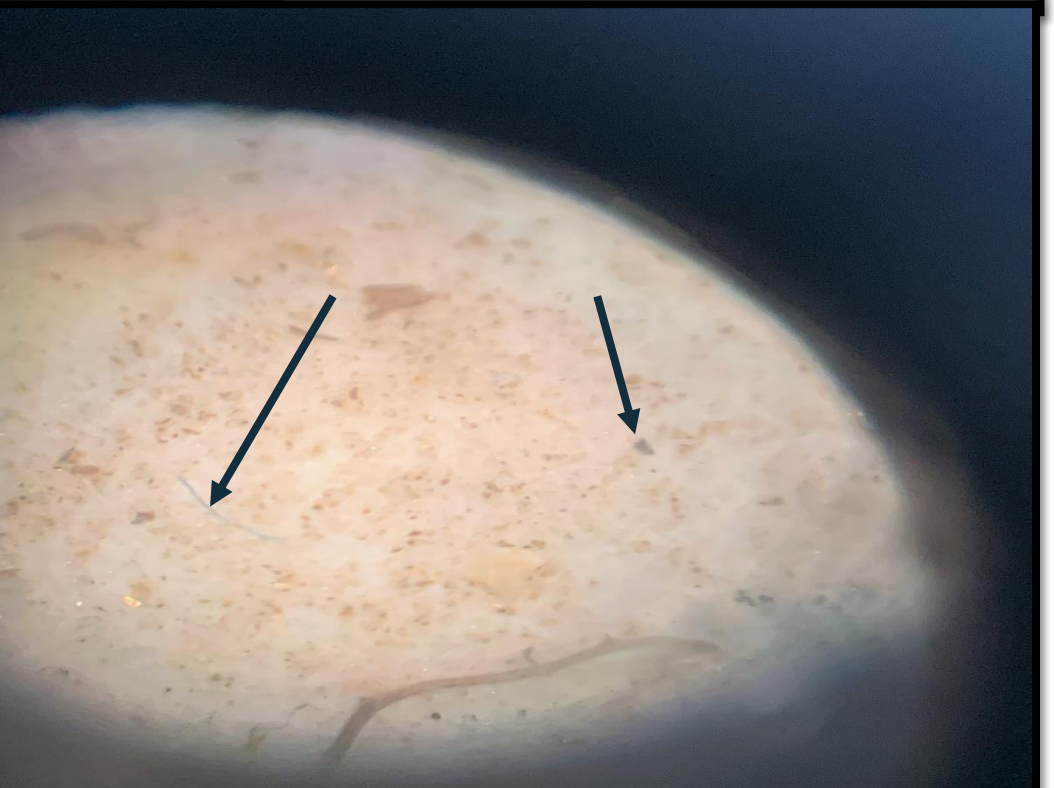

LOCATE AND IDENTIFY MICRO PLASTICS

- **Fish intestines:** previously all the organic matter in the intestines was degraded by means of acids and bases.
- Micro plastics can be seen in the form of fibers and fragments.
- The students declare that carrying out this activity was very valuable and that it helped them a lot to learn about the reality of micro plastics in our environment.

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Main results on the UD1: MICROPLASTICS

Questions: Very little 1 2 3 4 5 A lot	Students' opinion (out of 5)
To what extent do you expect training of these characteristics to improve sustainability in the industry?	4
Do you think that the session has served to increase your awareness of sustainability?	5
Do you consider sustainability education important within the industry?	4
Do you think that the methodology used contributes to your learning?	4
How would you rate the level of difficulty of the session?	4
Did the program respond to your professional educational needs?	4
Clarity of the class/exhibitions	5

Main results on the UD1: MICROPLASTICS

Questions: Very little 1 2 3 4 5 A lot	Students' opinion (out of 5)
Do you consider that the materials respond to the needs of the labor market?	4
Have you found the topics presented interesting?	3
Do you think the session has a practical application?	4
Have you acquired a lot of knowledge?	5
Do you think you will apply what you have learned during the program in your daily work?	4

DISSEMINATION

1. Dissemination of Raising Awareness of Microplastics another Students of Vocational Training"

2. Dissemination of Raising Awareness of Microplastics with 9 to 10 year boys of Primary Scool "PALMEIRA"

We understand that dissemination has to transcend borders, not just be pigeonholed in our studies of sea-related VET . That's why we decided to do it on two levels.

- In our school:
  - To other vocational trainees
- Outside our school:
  - Children aged 9-10 from surrounding primary schools were invited to our school

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Thank you!

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greedivingeuropeanproject

Green Diving

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Green Diving Project

UD5: BUILDING TWO STRIP CANOE

IMPACT OF BUILDING MATERIALS

Funded by the
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INTRODUCTION

- THE **MAIN** OBJECTIVE IS NOT TO EXPOSE HERE ALL THE ENVIRONMENTAL ADVANTAGES OF WOOD AS A SHIPBUILDING MATERIAL.
- IN THIS CLASS WHAT WE ARE GOING TO DO IS TO RAISE ENVIRONMENTAL AWARENESS TO THE STUDENT THROUGH THE REALIZATION OF A BOAT WITH SUSTAINABLE MATERIALS USING (AS FAR AS POSSIBLE) RECYCLABLE MATERIALS.
- WE HOPE THAT THIS **TECHINICAL MANUAL** WILL BE USED FOR OTHER SCHOOLS TO BE ABLE TO DEVELOP THE SAME ACTIVITY.

GREENDIVING

INTRODUCTION

Our TARGET GRROUP students are

- 14-20 Years Old **VET BASIC** STUDENTS
- Students from disadvantaged social backgrounds
- Students with fewer opportunities
- Families with few economic resources
- Students in many cases involved in problems related to drugs, mental illness, disabilities
- So for us environmental awareness is very important

GREENDIVING

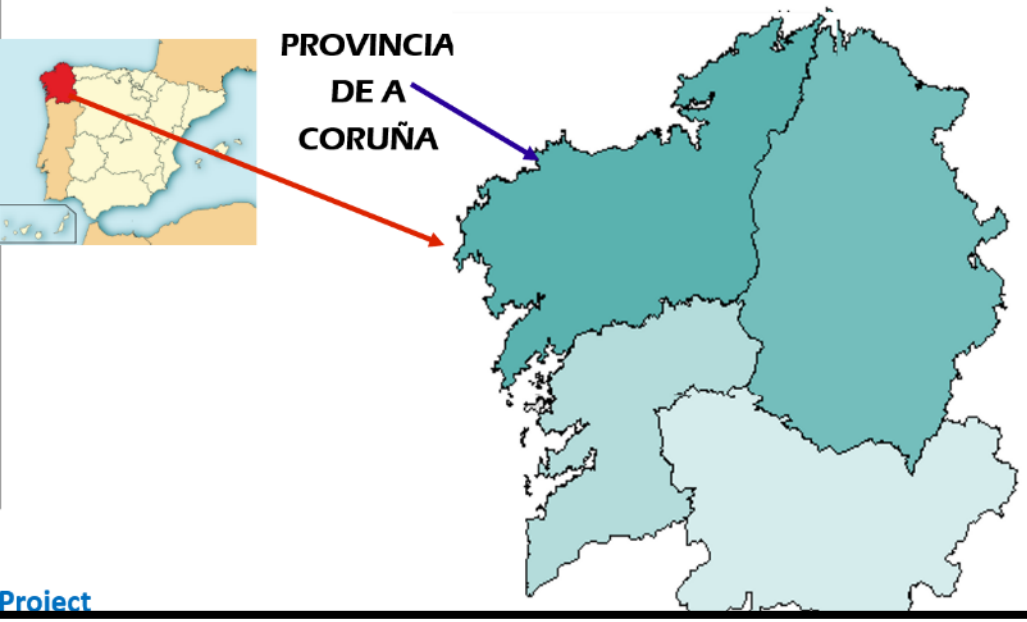
INTRODUCTION

Duration of the activity

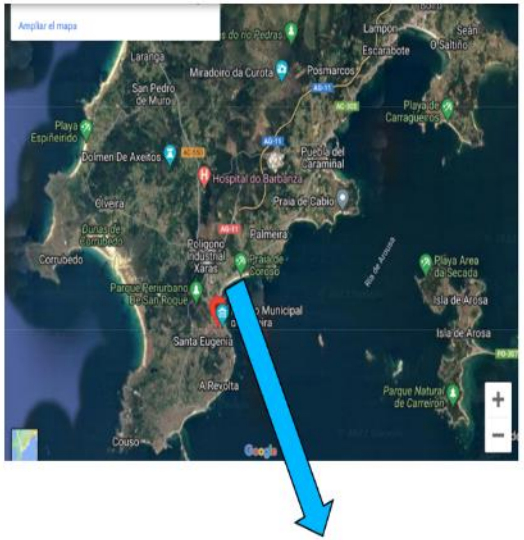
- Between 60 – 300 hours
- Depending on the availability of materials
- Depending on the ability of the students
- And other contingencies

GREENDIVING

LOCATION. PROVINCE OF A CORUÑA.



Project



C.I.F.P. COROSO

WHERE?

Project carried out in:

"CIFP COROSO" Training centre

cifp.coroso@edu.xunta.gal

The centre offers courses in the areas of **Maintenance of sports vessels.**

GREENDIVING

INDEX OF THE COURSE

IMPACT ON BUILDING MATERIALS

UD3: BUILDING TWO STRIP CANADIAN CANOES.

- **Learning objectives.**
  1) USE A SUSTAINABLE BUILDING MATERIAL.
  2) USE AS MANY RECYCLABLE MATERIALS AS POSSIBLE.
  3) PRODUCE AS LITTLE WASTE AS POSSIBLE.
  4) MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

Wood is a more sustainable material for building boats than other materials such as fiberglass or aluminum. Here are four reasons why:

GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

1.1. Wood is a renewable resource that can be grown and harvested sustainably. It is also biodegradable and can be recycled or repurposed at the end of its life.

GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

1.2. Wood has a lower carbon footprint than other materials because it requires less energy to produce and transport.

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GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

1.3. Wooden boats have a longer lifespan than boats made from other materials. They can last for decades with proper maintenance .

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GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

1.4. Wood is also more aesthetically pleasing than other materials and can add value to a boat.

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GREENDIVING

O1. USE A SUSTAINABLE BUILDING MATERIAL.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective1.** Use a sustainable building material.

Pine wood is a sustainable option for boat or ship building for several reasons.

- Compared to other woods, pine wood is easy to work with and has great availability and versatility.
- Additionally, pine wood is resistant and elastic, provides good thermal insulation
- dries quickly and is easily covered with paint due to its susceptibility to saturation.

GREENDIVING

O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- Recyclable materials are good to use when building a boat because they are environmentally friendly and sustainable. They can help reduce the amount of waste that ends up in landfills and oceans

GREENDIVING

O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

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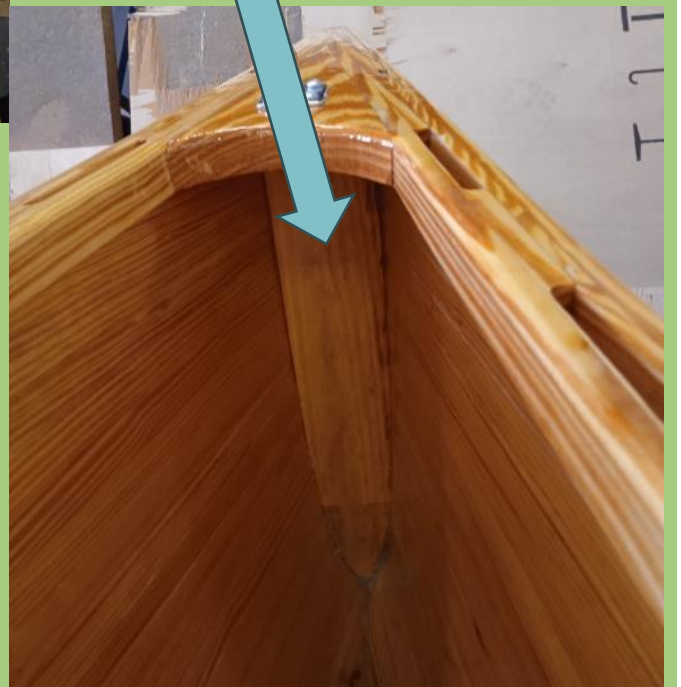
GREENDIVING



O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

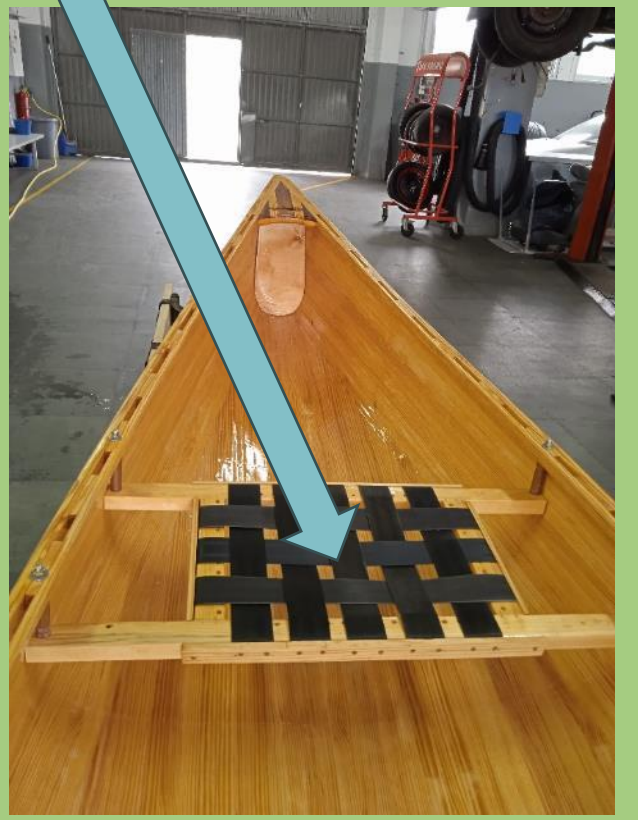
IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- the used pallets are used to make the internal details of the bow finish

GREENDIVING



O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

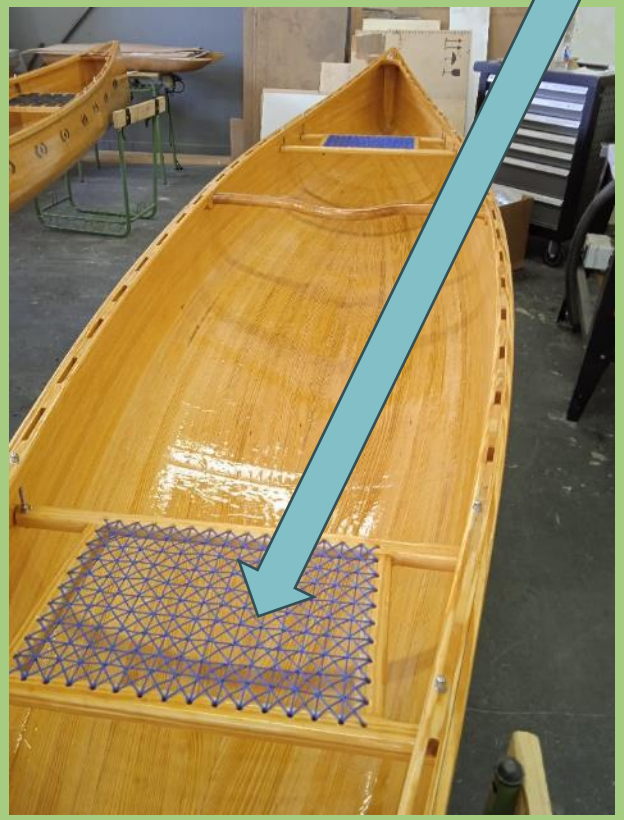
IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- Seat belts from junkyard cars are used to make seats for the first canoe.

GREENDIVING



O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- used marine ropes are used to make the seats of the second canoe

GREENDIVING

O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- Crossbars to preserve the shapes made with wood from a recycled pallet
-

GREENDIVING

O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- Melamine Board leftovers for making frames

GREENDIVING

O2. USE AS MANY RECYCLABLE MATERIAL AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective2. Use As Many Recyclable Materials As Possible.**

- homemade support for canoe

GREENDIVING

O3. PRODUCE AS LITTLE WASTE AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

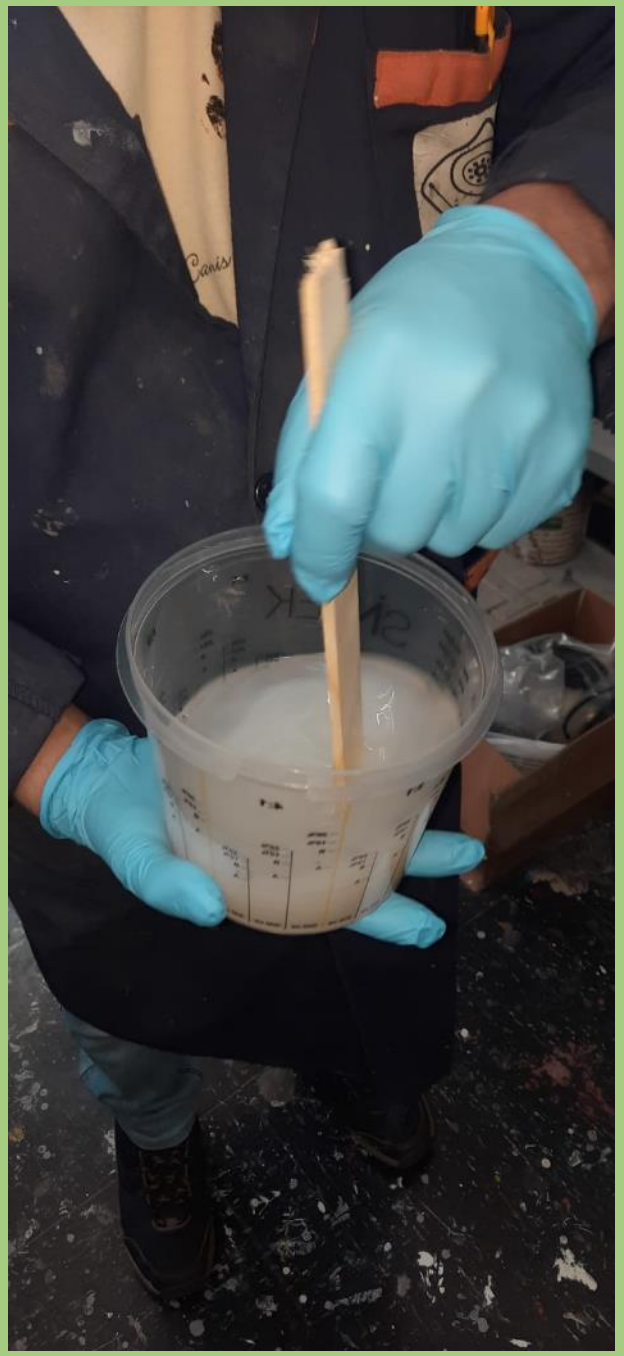
UD3: BUILDING A WOOD CANOE.

- **Objective3. Produce as little waste as possible**

Residue	Generated	Quantity	Treatment	Notes
Wood	Slat trimming Auction clippings Sawdust Chips	20 kg	Incineration	It were burned on a heating stove

GREENDIVING

GREENDIVING



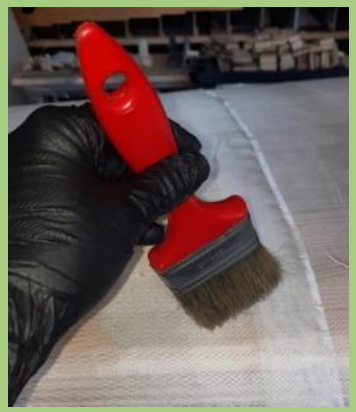
O3. PRODUCE AS LITTLE WASTE AS POSSIBLE.

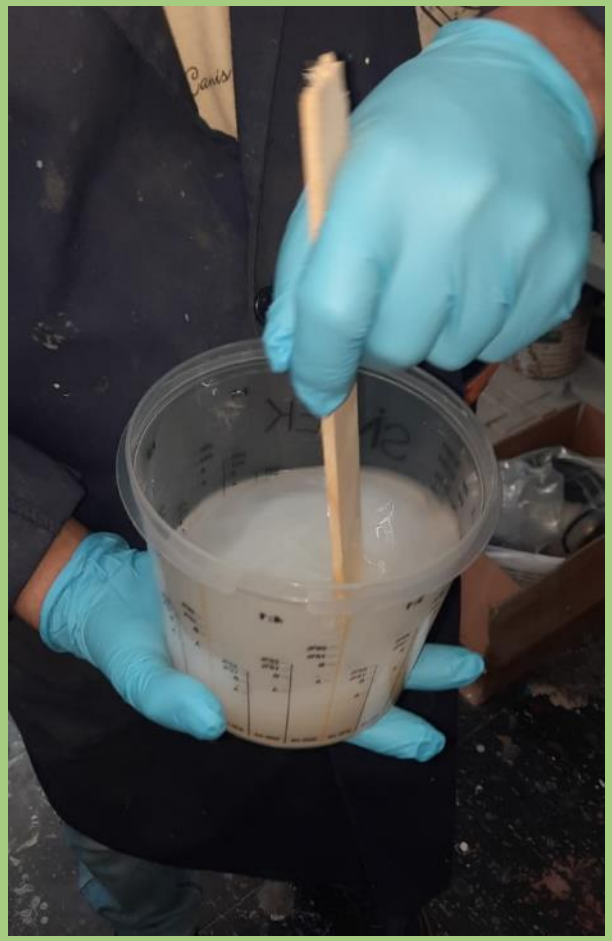
IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective3. Produce as little waste as possible**

Residue	Generated	Quantity	Treatment	Notes
Fiberglass	nothing	0	Not applicable	No waste is generated since the fiber is cut as needed and the possible remains of cuts were either used in reinforcement points or as part of filling in reinforcement areas.
Rexin epoxy	nothing	0	Not applicable	No residues of epoxy resin were generated because by carrying a slow process catalyst (13 hours) quantities of 500 gr were prepared and the amount was adjusted to the needs, with this it was possible to eliminate the generation of waste and save costs





O3. PRODUCE AS LITTLE WASTE AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective3. Produce as little waste as possible**

Residue	Generated	Quantity	Treatment	Notes
Paint cup	Resin application	4 glasses (1100ml glasses)	Plastics	Although there was no resin left over the glasses they had a film that covered them, once dry it came out easily.
Rollers	Resin application	12 pcs	Plastics	
Brushes	Resin application	2 pcs	Plastics	

GREENDIVING

O3. PRODUCE AS LITTLE WASTE AS POSSIBLE.

IMPACT ON BUILDING MATERIALS

UD3: BUILDING A WOOD CANOE.

- **Objective3. Produce as little waste as possible**

Residue	Generated	Quantity	Treatment
Gloves	Resin application	16 pairs	Plastics
Masks	Resin application	12 pcs	Plastics
Staples	Withdrawals from the manufacturing process	300 gr	Metals

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

1. Presentation of the canoe project
2. Plans and transfer to the frames
3. Cutting of frames (shape)
4. Staking out and preparing bed
5. Placing frames on bed
6. "Bead and Cove" on the slats
7. Laying covering strips
8. Trimming ends and removing staples
9. Sanding and brushing
10. Application of epoxy resin

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

11. Placement fiberglass blanket
12. Preparation canoe supports
13. Sanding + resin + fiber inside
14. Stakeout for seating and yoke
15. Embroidery laying
16. Yoke
17. Seats
18. Bow and stern finials
19. Varnishing
20. We just finished

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

1. Presentation of the canoe project

Procedure:

- Students are explained the different construction techniques. For the elaboration of the plans two methods are followed:
- The plans are projected with a barrel on a sheet to the required scale and copied with a label.
- They are compressed on paper (A1) at 1/1 scale

Materials:

Paper

Tools:

Projector cannon

Large format printers (A1)

2. Plans and transfer to the frames

Procedure:

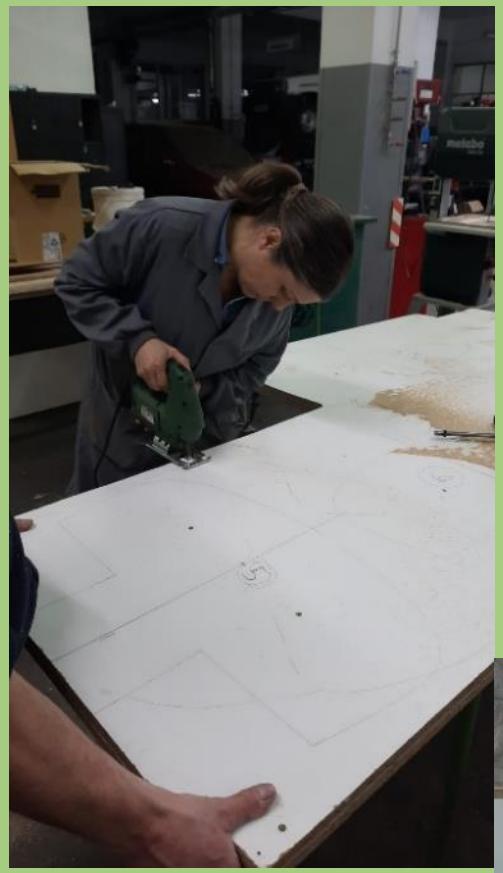
- Once the forms are copied on paper, they are transferred to the wood to cut them

Materials:

Melamine board

Tools:

Marker



O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

3. Cutting of frames (shape)

Procedure:

- Cut board to create the shape, they are cut two by two for being this canoe symmetrical

• Materials:

- Melamine board

• Tools:

- Marker
- Calar saw
- Vertical band saw

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

3. Cutting of frames (shape)

Procedure:

- In the canoe that chose to print the plans, the paper was glued on a board and proceeded to cut it. This canoe unlike the previous one is not symmetry with what all the shapes had to be made. First one half of the form is made and then the other half is copied with the tupi

• Materials:

- Melamine board

• Tools:

- Calar saw
- Vertical band saw

3. Cutting of frames (shape)

Procedure:

- Copied from the form with the tupi and union of the two halves. Observe the vertical and horizontal line that were marked because this will allow us in later steps to rethink the shapes in vertical and horizontal position

• Materials:

- Melamine board
- Screws

• Tools:

- Tupi of artisan manufacture
- Electric screwdriver
-

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

4. Staking out and preparing bed

Procedure:

- Stakeout and preparation of the bed that will receive the forms.
- Realization of hole for the passage of the guide string for the alignment of the shapes

• Materials:

- Wooden board 5000x300x50
- Perpendicular slats of 300x30x30
- Screws 5x50

• Tools:

- Square, Screwdriver drill
- Column logger

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

5. Placing frames on bed

Procedure:

- Placement of the shapes on the bed using a guide string for a correct alignment of the shapes

• Materials:

- 5x40mm screws
- Ø3mm thread

• Tools:

- Jaws
- Electric screwdriver
- Level

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

5. Placing frames on bed

Procedure:

- Staking out and placing the shapes with a laser level, using the vertical and horizontal lines previously drawn in the shapes

• Materials:

- 5x40mm screws

• Tools:

- Jaws
- Electric screwdriver
- Laser level

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

6. "Bead and Cove" on the slats

Procedure:

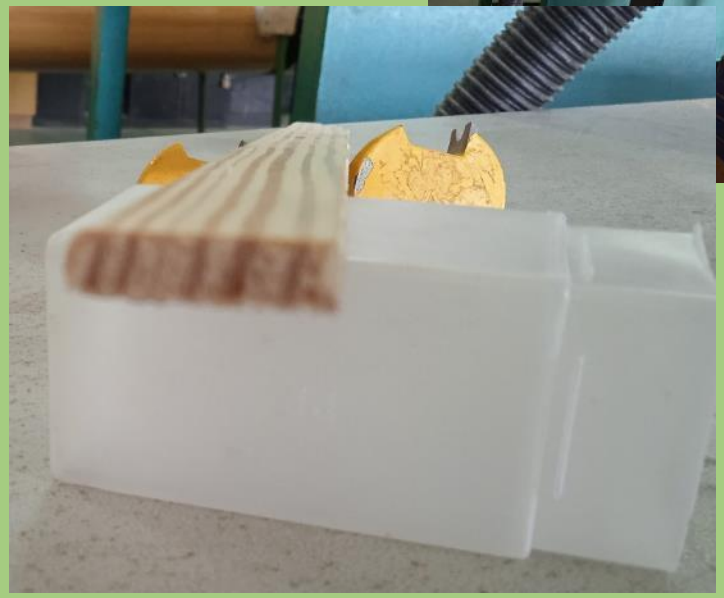
- Sta Preparation of the table for the realization of the "Bead and Cove" in the slats

• Materials:

- Wooden slats 5300x22x5mm

• Tools:

- Tupi of artisan manufacture



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• Materials:

- Wooden slats 5300x22x5mm

• Tools:

- Tupi of artisan manufacture

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

- Placement of the first strips of the covering.
- Very important the placement of the first strip of slats, it should be as horizontal as possible

• Materials:

- Wooden slats with "Bead and Cove“
- Wood glue (glue)
- Staples 14mm

• Tools:

- Manual stapler
- Handsaw (kataba)

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

- Placing the first strips of the cover in the second canoe

• Materials:

- 5300x22x5mm wooden slats with "Bead and Cove"
- Wood glue (glue)
- Staples 14mm

• Tools:

- Manual stapler
- Handsaw (kataba)

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

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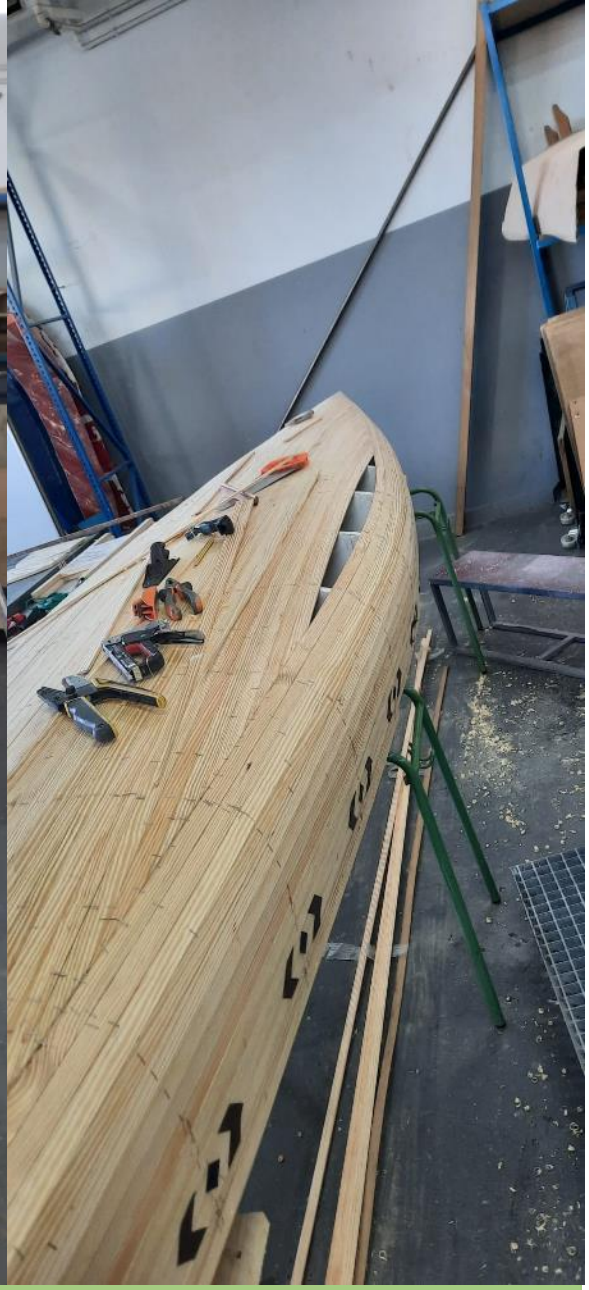
GREENDIVING



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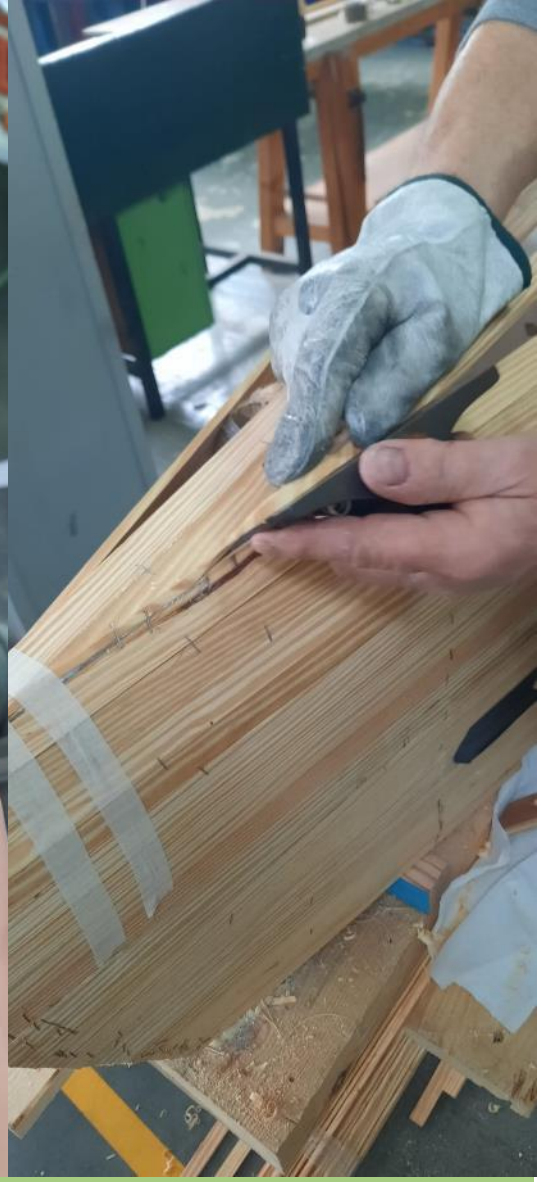
GREENDIVING



O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

- Placing the last strip of the flat bottom

• Materials:

- 5300x22x5mm wooden slats with "Bead and Cove"
- Wood glue (glue)
- Staples 14mm

• Tools:

- Jaws
- Handsaw (kataba)
- Brushes

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

- Formation of a "V" bottom side

• Materials:

- 5300x22x5mm wooden slats with "Bead and Cove"
- Wood glue (glue)
- Staples 14mm

• Tools:

- Manual stapler
- Jaws
- Handsaw (kataba)
- Slings
- Draw lines

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

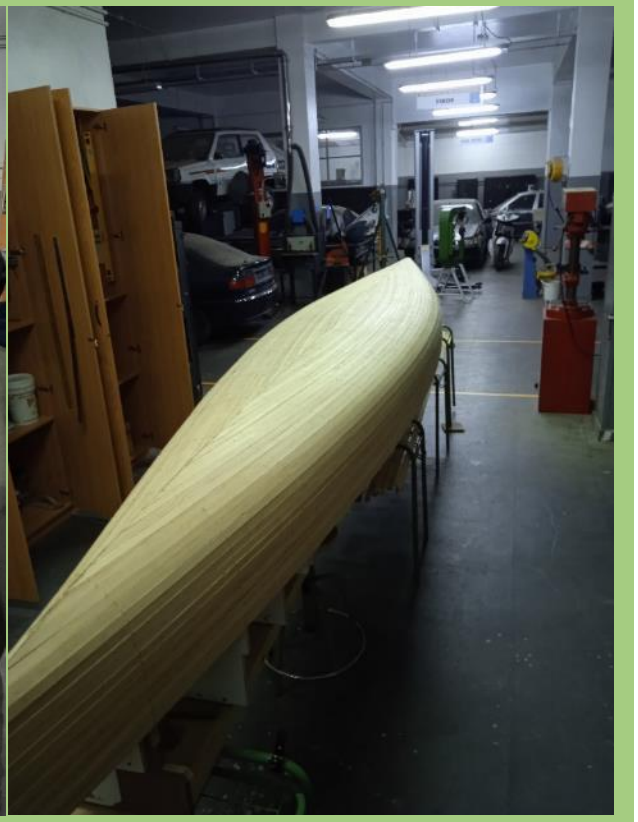
- Formation of the other side of the background in "V"

• Materials:

- 5300x22x5mm wooden slats with "Bead and Cove"
- Wood glue (glue)
- Staples 14mm

• Tools:

- Manual stapler
- Jaws
- Handsaw (kataba)
- Slings
- Draw lines



O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

7. Laying covering strips

Procedure:

- Placement of the last piece of the background in "V"

• Materials:

- 5300x22x5mm wooden slats with "Bead and Cove"
- Wood glue (glue)
- Staples 14mm

• Tools:

- Manual stapler
- Jaws
- Handsaw (kataba)
- Slings
- Draw lines

8. Trimming ends and removing staples

Procedure:

- Trimming ends and removing staples

• Tools:

- Handsaw (kataba)
- Staples Remover
- Pliers

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

8. Sanding and brushing

Procedure:

- Sanding and planing of canoes for surface equalization and smooth finish

• Tools:

- Sandpaper cleats
- Sander "Rotoorbital"
- Brushes
- Planer

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

10. Application of epoxy resin

Procedure:

- Preparation of epoxy resin for application. Important to keep in mind the manufacturer's instructions

• Materials:

- Epoxy resin

• Tools:

- Glass of paint to make the mixture
- Precision balance

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

10. Application of epoxy resin

Procedure:

- Imprimación con resina epoxi de la parte exterior de la canoa

• Materials:

- Epoxy resin

• Tools:

- Precision scale
- Paint cups
- Rollers
- Brushes

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

11. Placement fiberglass blanket

Procedure:

- Placement of the fiberglass blanket (110gr/m2) on the hull

• Materials:

- Fiberglass (110gr/m2)

• Tools:

- Paintbrush
- Tweezers clothes
-

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

11. Placement fiberglass blanket

Procedure:

- Application of epoxy resin to fiberglass blanket

• Materials:

- Epoxy resin

• Tools:

- Precision scale
- Paint cups
- Rollers
- Brushes

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

11. Placement fiberglass blanket

Procedure:

- Placement of a second layer of fiberglass on the bottom and the bow and stern as reinforcement

• Materials:

- Epoxy resin

• Tools:

- Paintbrush
- Body tape to hold the fabric

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

12. Preparation canoe supports

Procedure:

- Preparation of the supports to place the hulls of the canoes once dry from the beds.
- Before removing the canoe gives bed it is important to mark where the boards will be placed, using as a reference the auction of the forms "

• Materials:

- old desks
- Pallet wood
- End-of-life car seat belts

• Tools:

- Electric taladro
-

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

12. Preparation canoe supports

Procedure:

- Removal of the canoe from its forms and placed on a support. Some of the shapes were kept so that the helmet did not lose its shape

• Materials:

- Canoe shapes

• Tools:

- Slings

13. Sanding + resin + fiber inside

Procedure:

- Lijado de la parte interior de la canoa y posterior aspirado y limpiado

• Tools:

- Sandpaper cleats
- Rotoorbital Sander
- Brushes
- Planer

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

13. Sanding + resin + fiber inside

Procedure:

- Placement of fiber on the inside and application of epoxy resin

• Materials:

- Fiberglass fabric (110gr/m2)
- Epoxy resin

• Tools:

- Paintbrush
- Tweezers clothes
- Precision scale
- Paint cups
- Rollers
- Brushes

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

13. Sanding + resin + fiber inside

Procedure:

- Placement of fiber on the inside and application of epoxy resin

• Materials:

- Fiberglass fabric (110gr/m2)
- Epoxy resin

• Tools:

- Paintbrush
- Tweezers clothes
- Precision scale
- Paint cups
- Rollers
- Brushes

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

14. Stakeout for seating and yoke

Procedure:

- Stakeout of the inner edge, to locate the situation of the seats and the yoke

• Materials:

- Wooden batten 5300x22x10mm
- Epoxy resin
- 3x20mm screws

• Tools:

- Tape measure
- Milling machine, Paint cups
- Jaws Paintbrush
- Electric screwdriver
- Precision scale

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

15. Embroidery laying Procedure:

- Placement of inner embroidery

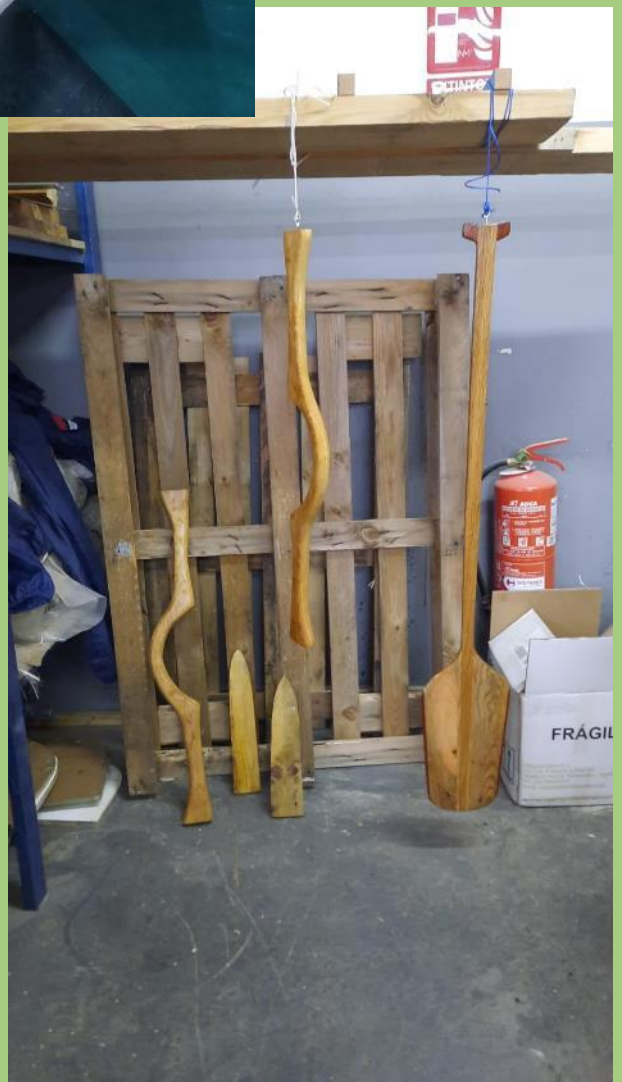
• Materials:

- Wooden batten 5300x22x10mm
- Epoxy resin
- 3x20mm screws

• Tools:

- Tape measure
- Milling machin, Jaws
- Paintbrush
- Electric screwdriver
- Precision scale, Paint cups

GREENDIVING



O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

16. YOKE

Procedure:

- Yoke design and subsequent varnishing

• Materials:

- Wooden board 1000x300x30mm

• Tools:

- Marker
- Vertical band saw
- Orbital sander
-

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

17. Seats

Procedure:

- Seat preparation

• Materials:

- Wooden slats 800x25x25mm
- Stripping seat belt tape for braiding the seat

• Tools:

- Vertical band saw
- Column drill

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

18. Bow and stern finials

- **Procedure:**
- Preparation of bow and stern finishes
- **Materials:**
- Wooden board
- Pallet board
- Epoxy resin
- **Tools:**
- Vertical band saw
- Paintbrush
-

GREENDIVING

O4. MAKING THIS KNOWLEDGE AVAILABLE TO EVERYONE

19. Varnishing

- **Procedure:**
  - Canoes in the paint booth for varnish application
- **Materials:**
  - Acrylic varnish
- **Tools:**
  - Paint booth
  - Paint gun

20. We just finished

- **Procedure:**
- Checking buoyancy

CONSORTIUM

CETMAR
CENTRO TECNOLÓGICO DEL MAR

INOVA+
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Thank you!

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