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MODULE 6

environment and waste management

trainer's booklet

raise awareness about waste types, recycling, reuse, and composting processes.

IDEA Universal (Turkey)
DUTH (Greece)
UABSC (Ukraine)
İO-BAS (Bulgaria)

ENVIRONMENT AND WASTE MANAGEMENT

NO	ACTIVITIES	STATUS
1	Design by Using Waste Materials	160 minutes
2	Turning Organic Waste into Compost	80 minutes
3	Clean Up Challenge (Field Trip)	120 minutes

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BACKGROUND

Waste or Garbage?

Waste is defined as any substance resulting from production and consumption processes that may have negative effects on human and environmental health if left in nature. Recyclable materials such as paper, glass and plastic are separated from waste and made reusable. However, residual materials that cannot be recycled or repurposed in any way are considered **garbage**.

Waste Types

Paper

The main raw material of paper is forests. Paper waste should be collected separately and kept dry, away from other wastes. Examples of paper waste include newspapers, magazines, books, notebooks, cardboard boxes, and paper packaging. Recycled paper is reused in the production of paper and cardboard, helping to conserve natural resources. Recycling one ton of paper prevents the cutting down of 17 trees, reduces 12,400 m^3 of greenhouse gas emissions, and saves 26,500 liters of water, 4,100 kWh of energy, and 2.4 m^3 of landfill space.

Plastic

Plastic is a synthetic material delivered from petroleum and its derivatives, and has different types according to its chemical structure. Plastics are classified for recycling through symbols displayed on products. For example, **plastic 1 (PET)** is commonly found in water bottles, juice boxes and transparent packaging. When recycled, it is used as fiber and filling material in the textile and furniture industries. **Plastic 2 (HDPE),** often used in detergent and shampoo bottles, can be recycled into new plastic bottles. However, **plastic 3 (PVC)** is used for pipes, window frames and some bottle caps and is more difficult to recycle. **Plastic 4 (LDPE)** is used in stretch f ilm, plastic bags and some clothing labels, while **plastic 5 (PP)** is used in yogurt containers, plastic cutlery and bottle caps and has limited recycling. **Plastic 6 (PS)** appears in disposable plates, cups and some toys and is more economically challenging to recycle. **Plastic 7 (other)**, found in baby bottles, carboys and some packaging, is often complex to recycle and is sometimes not recyclable at all.

Extinction Period of Some Wastes in Nature

Paper Towel 2-4 weeks

Orange peel 6 months

Cigarette butt 2-5 years

Chewing Gum 5 years

Plastic bags **10-20 years**

Paper cup 50 years

Battery 100 years

Plastic bottle 450 years

Glass bottle 1 million years

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Glass

The basic raw material of glass is sand. Sand, soda and lime are melted at approximately 1500°C and then cooled in a controlled manner to produce glass. Examples of glass waste include glass food containers, bottles, and jars. Used glass waste can be recycled and reused in glass production, thus reducing the consumption of natural resources and energy use. Glass is a 100% recyclable material and can undergo an unlimited number of recycling processes. Recycling just one glass bottle saves enough energy to run a computer for about 25 minutes, a television for 3 hours and a 100 watt light bulb for 4 hours.

Metal

Metals are obtained by processing and refining various minerals from the earth. Recycling metal waste requires much less energy than mining to produce new metals. Through this process, metal waste can be reused, supporting sustainable material production. Examples of metal waste include beverage cans, tin cans, metal lids, and staples. Like glass, Aluminum is 100% recyclable. The production of recycled aluminum beverage cans emits 95% less greenhouse gases and consumes 95% less energy compared to producing aluminum from raw materials. An aluminum beverage can be back in stores just 60 days after being placed in the recycling bin. This shows how quickly and efficiently aluminum can be recycled.

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Organic Waste

Examples of organic waste include vegetable and fruit peels, leaves and twigs, coffee grounds, and eggshells. Organic wastes can be recycled through composting, which contributes to soil health at all.

Vegetable Waste Oil

Used frying oils, expired solid and liquid vegetable oils are examples of this type of waste. Vegetable waste oils can be processed for biodiesel production or treated through special methods.

Waste Battery

End-of-life phone batteries, watch batteries, and toy batteries are examples of waste batteries. Since the chemicals in batteries can harm the environment, it is important to collect and recycle them properly.

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Electronic Waste

Old televisions, computers, phones, electrical kitchen appliances are examples of electronic waste. This type of waste must be properly recycled due to the precious metals and hazardous substances it contains.

Medical Waste

Examples of medical waste include used medical gloves, needles, medicine boxes, and patient care materials. These wastes should be disposed of under special procedures as they pose a health risk.

Hazardous Waste

Chemical cleaning products, paint cans, packaging containing acidic substances, and pesticides are examples of hazardous waste. These wastes need to be disposed of safely.

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Compost

Compost, a dark-colored, easily crumbly material with an earthy smell, is a natural recovery product obtained by biological decomposition of organic waste under appropriate environmental conditions.

Why Compost?

There are many important advantages of using compost. It improves soil fertility, maintains moisture balance and helps prevent plant diseases and pests. It also regulates soil pH levels and contributes to environmental protection by reducing the use of chemical fertilizers. By decomposing organic matter, compost promotes the growth of beneficial bacteria and fungi, which in turn create nutrient-rich humus for plants. It also reduces the carbon footprint by reducing methane gases from landfills. The composting process requires a balance of green and brown materials, as well as air and moisture. Green materials provide a source of nitrogen and brown materials provide a source of carbon. Examples of green materials include fresh herbs, coffee grounds, fruit and vegetable peels. Dry leaves, sawdust, straw, paper are brown materials.

Materials that cannot be composted

Meat, fish, dairy products, fatty foods, plastic, glass, metal materials, diseased plants or wastes containing chemicals are not suitable for composting.

What is Vermicompost?

Vermicomposting is obtained by digesting organic waste by worms and converting it into fertilizer. Vermicomposting supports the growth of plants, increases the water holding capacity of the soil and allows it to breathe.

Which Worms Can Be Used?

Earthworms used in composting are not the same as earthworms commonly encountered in nature. Although there are more than 9,000 species of earthworms in the world, only some species are suitable for composting. The most commonly used species is the Red California Worm (Eisenia fetida). You can buy these worms from worm farms or from worm composters.

Suitable Conditions for Vermicomposting Worms

	Limit Values	Ideal Value
pH	5-9 pH	7 pH
Temperature	0-35 °C	15-25 °C
Humidity	% 60-90	% 80

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For the healthy growth of compost worms, they need to be protected from sunlight, extreme heat and cold. Suitable organic waste should be used for feeding, for example fruit and vegetable waste, coffee grounds and crushed eggshells. However, citrus fruits, onions, garlic, meat and dairy products, fatty foods, bones and pet waste should be avoided. Since worms are skin breathers, it is important that their habitat is moist and breathable. The worm bed should be slightly damp, but not so wet that water drips. The depth of the compost bin should not exceed 50 cm and it should have holes for excess water to drain away. Also, 0.5 kg of compost worms (about 1,000 worms) will be enough for 0.5 kg of food waste generated in a week.

How to Do Vermicomposting?

T**ools and Materials:** Compost bin (ready-made or self-made), mosquito netting, organic waste, 0.5 kg Red California Worms, soil, gloves, water

The process of preparing vermicomposting consists of five stages.

1. Preparing the Compost Bin. You can buy a compost bin or make your own. You can use a dark-colored, 20L plastic bin and make ventilation holes in the bottom and sides. You can place another box under the box to allow the liquid fertilizer to accumulate.

2. Choosing a suitable location. The temperature, light and humidity balance of the compost bin is important. The ideal temperature should be between 15-25°C and avoid direct sunlight. The compost should be moistened at regular intervals.

3. Preparing the Worm Bed. Materials such as non-glossy newsprint, cardboard and dry leaves can be used. The materials are soaked in water for 10 minutes, squeezed and placed in the box. After adding humus soil and watering, wait 1-2 days and add compost worms.

4. Adding Organic Waste. Organic waste should be added evenly and carefully on top of the bedding material. The waste should be 1-2 cm high and covered with bedding material each time. The waste should be broken into small pieces so that the worms can digest it faster.

5. Harvesting. You can leave the worms back by hand sorting your compost. Alternatively, you can push the contents aside and add new organic waste. The worms will gather around the new waste.

Vermicompost Troubleshooting Guide

NO	SYMPTOM	POSSIBLE PROBLEM	SOLUTION
1.	Bad odor	Compost bin too wet; food waste exposed	Cover food waste with dry bedding material. Open the lid. Do not add new waste for 2 weeks.
2.	Attract flies	Food waste exposed	Cover food waste with bedding material.
		Too much fruit waste	Reduce fruit waste. Do not add new waste for 2 weeks.
3.	Worms dying	Compost bin too wet	Add dry bedding material.
		Compost bin too dry	Add water until slightly damp. Add moist bedding material if necessary.
		Not enough oxygen in the compost bin	Open new ventilation holes.
		Too hot	Too hot move the bin to a place where the ambient temperature is 15-25oC.
		Ran out of bedding material and waste	Harvest the compost. Add new bedding material and organic waste.

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DESIGN BY USING WASTE MATERIALS

Ages 8-15

Environment and Waste Management

160 minutes

Key Concepts

- Waste
- Waste Types
- Recycling
- Upcycling

Purpose: This activity aims to enable students to identify different types of waste, gain awareness of waste management, and to develop a product using the engineering design process

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Learning Outcomes

By the end of this activity, students will be able to:

- Classify different types of waste.
- Analyze the steps involved in waste management
- Construct the importance of zero waste approach
- Design a product using the engineering design process

Materials

Waste materials (cardboard, paper, plastic bottles, etc.), glue, silicone gun, silicone candle, colored stickers, and worksheets
For paper making: Wooden frame, Mosquito net, Stirrer, Plastic storage box, Blow dryer, Sponge, Pushpin

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EDUCATOR GUIDELINES

Step 1

The instructor grabs the students' attention with a short Q&A activity. Students are asked questions such as "Can you explain the difference between garbage and waste? What do you know about the environmental impacts of uncontrolled release of waste into the environment?". The instructor gives examples of how long some products last in nature and talks about waste types and recycling (10 minutes).

Step 2

In this activity, students work in teams and make a design from waste using the engineering design process. First, students read the design problem and identify the problem situation and the criteria and constraints that the design should meet (5 minutes).

Step 3

The instructor asks students "Which problem or need does your design solve? Who will be your target audience? Which waste types will you use in your design? What is the proportion of waste materials used in your design?" Students brainstorm and create several design ideas (10 minutes).

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Step 4

Team members brainstorm and evaluate their design ideas in terms of the criteria and constraints. Then they choose the best design idea and explain it by sketching it on the worksheet (15 minutes).

Step 5

Teams determine their designs according to their own imagination using the given materials and prepare the prototype. The materials used in the design and their quantities are recorded on the worksheet (20 minutes).

Step 6

Teams test their prototypes in terms of criteria and constraints and determine their successes and failures. Teams present their prototypes in front of other teams. In addition, they evaluate their own designs or the designs of other teams with the help of rubrics. Team members discuss the unsuccessful aspects of their prototypes and decide on improvements to be made (20 minutes).

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Differentiation

An activity for recycling paper can be carried out with middle school level students by following the steps below.

- Waste paper is cut into small pieces and turned into dough with the help of a mixer and some warm water.
- The dough mixture is poured into the plastic box.
- Fly screen tulle is stretched on the wooden frame and fixed with the help of thumbtacks or staple gun. (With the support of the instructor)
- Immerse the net stretched frame into the mixture and remove the frame when the mixture fills the surface of the frame. Wait 1-2 minutes for the water to drain.
- Press the wooden mold into the frame and allow the excess water to drain.
- Turn the frame upside down and remove the paper pulp on a flat surface together with the wooden mold.
- Press the pulp carefully with a sponge and absorb the remaining water.
- Finally, dry the paper completely with a blow dryer.

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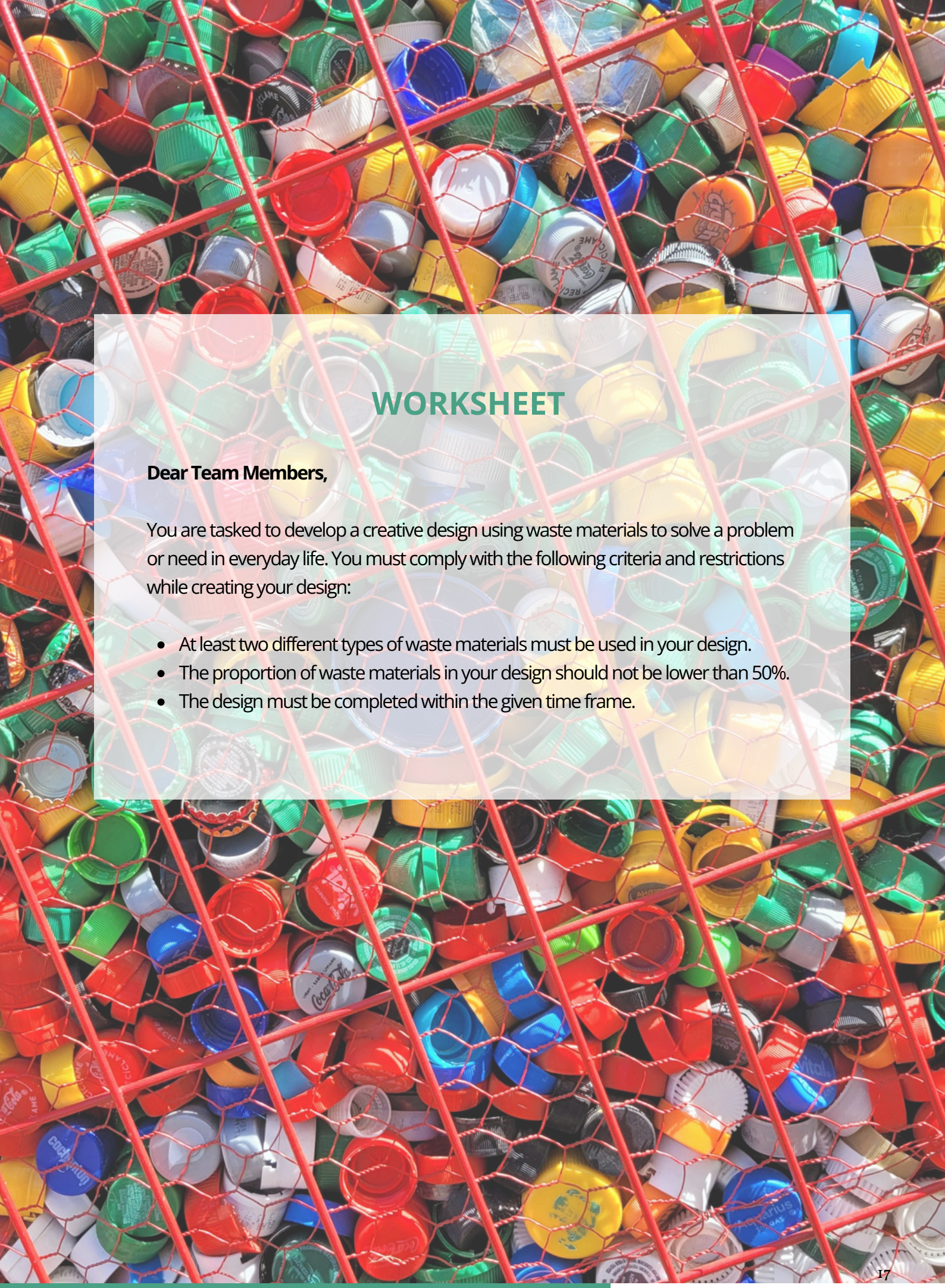

WORKSHEET

Dear Team Members,

You are tasked to develop a creative design using waste materials to solve a problem or need in everyday life. You must comply with the following criteria and restrictions while creating your design:

- At least two different types of waste materials must be used in your design.
- The proportion of waste materials in your design should not be lower than 50%.
- The design must be completed within the given time frame.

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Step 1: Identifying the Need/Problem

What kind of design are you planning to make? What are your criteria and constraints?

Step 2: Research

Do research on the design to be developed. Read the Theoretical Background section to fill in the gaps in your knowledge about the design topic.

Step 3: Developing Solution Proposals

Brainstorm with your teammates to identify possible design ideas.
My design ideas and sketches:

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Step 4: Choosing the Best Possible Solution

Considering the criteria and constraints, determine the most appropriate solution proposal by "joint decision".

Draw the solution you have decided on for the prototype.

Specify the materials to be used in your prototype

State its features, its function in design, reasons for preference and alternatives.

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Step 5: Prototyping

Prepare the prototype that you have determined with a joint decision.

Step 6: Testing and Evaluation

Evaluate whether your prototype meets the problem/need you have identified. Determine the types of waste you used and calculate the waste material ratio. Compare the data you obtained with the data of other teams.

Design Evaluation Table

Team	Design Features	Relevance to the Need/ Problem	Waste Types	Waste Material Proportion

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Based on the data obtained, which team has the best design and what could be the reason for this?

Step 7: Sharing the Solution

Make a presentation of your design, test and evaluation results and share it with other teams.
What are the criteria and constraints it provides? What is your evidence based on your observations? Are there any aspects that are missing or need to be improved? Share with other teams.

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Step 8: Redesign

What are the successes and failures of your design?

Successful Aspects	Unsuccessful Aspects

What changes can be made to optimize your design?

Step 9: Completion

The design process continues until your design meets all criteria and constraints.

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TURNING ORGANIC WASTE INTO COMPOST

Ages 8-15

Environment and Waste Management

80 minutes

Key Concepts

- Compost
- Vermicompost
- Green material
- Brown material

Purpose: This activity aims to allow learners to explore the vermicomposting, and its role in organic waste recycling and agriculture.

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Learning Outcomes

By the end of this activity, students will be able to:

- Construct the benefits of compost
- Compare the impact of compost on agriculture
- Analyze the production of vermicomposting

Materials

Vermicomposting bin, brown materials (dry leaves, twigs, bark, etc.), green materials (fruit and vegetable waste, mowed grass residues, etc.), pH probe, Temperature probe, Ruler, Gloves

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EDUCATOR GUIDELINES

Step 1

The instructor begins with a short question and answer activity. "Can you give examples of organic waste?, Is it possible to recycle organic waste? How? The instructor talks about compost, the benefits of compost, composting methods and compost troubleshooting (20 minutes).

Step 2

In this activity, students work in teams to evaluate the quality of the compost by measuring and observing (temperature, pH, color and smell) in different parts of the worm compost bin. At this stage, the instructor asks students "What should the temperature and pH be like in vermicomposting?, What does the compost content look like?, What do you see when you look closely at earthworms?, Do they have eyes?, How do they breathe?, What do you think about the quality of the compost?, Do you think the compost is ready? Why?" If students identify problems, they offer appropriate solutions using the Compost Troubleshooting Guide. Students answer the questions on the worksheet in line with their measurements and observations (40 minutes).

Step 3

Students go to the plant growing beds and examine the effect of compost use on plant height. Dependent, independent, and controlled variables are discussed (dependent variable: plant height; independent variable: use of compost; controlled variables: planting time, plant type, soil, sunlight, water, air, temperature). Students measure and compare the height of plants grown in soil with and without compost. Then they answer the questions on the worksheet based on their measurements and observations (20 minutes).

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WORKSHEET

Dear Team Members,

In our center, we turn organic waste into worm compost for the healthy growth of plants in the garden. You are expected to evaluate the compost quality in the vermicomposting production area. Then you are asked to move to the plant growing area and evaluate the effect of compost on plant height.

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Step 1

Visit the area where the vermicompost bin is located in the center.

Step 2

Analyze the quality of the compost in the vermicompost bin. Divide the compost bin into equal zones and record your observations for the different zones in the table.

Date	Region	Temperature	pH	Color	Smell

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Step 3

According to the data you obtained, do you think the compost is ready for use? Explain why.

Step 4

Do you think there are problems with the compost? Use the 'Compost Troubleshooting Guide' to identify any problems and solutions.

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Step 5

How do you think the use of compost affects plant height? Do you think plants grow better in soil with or without compost? Record your predictions with reasons.

Step 6

Visit the plant growing beds in the center and observe how composting affects plant height. Record your observations in the table.

Date/ Time	Plant Height	
	Soil with Compost	Soil without Compost

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Step 7

Do your observations match your predictions? In which soil are the plants taller? What do you think might be the reason for this? Discuss with your teammates.

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CLEAN UP CHALLENGE

Ages 8-15

Environment and Waste Management

120 minutes

Key Concepts

- Waste Types
- Environmental Pollution

Purpose: This activity aims to enable learners to deepen their understanding of the environmental impact of human activities while fostering a stronger connection with nature.

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Learning Outcomes

By the end of this activity, students will be able to:

- Classify types of waste
- Structure the impact of human activities on the environment.
- Analyze the effects of different types of waste on the environment

Materials

Gloves, garbage bags, mobile application (Litterati, Excel)

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EDUCATOR GUIDELINES

Step 1

The instructor begins with a short question and answer activity. Students are asked "What are the types of waste?, What is environmental pollution? What is its impact on the environment and people?" and talks about waste types, environmental pollution and the impact of human activities on the environment (duration: 20 minutes)

Step 2

The instructor informs the students that they will clean the designated area in teams. He/she warns the students to use protective equipment and gives each student a garbage bag.

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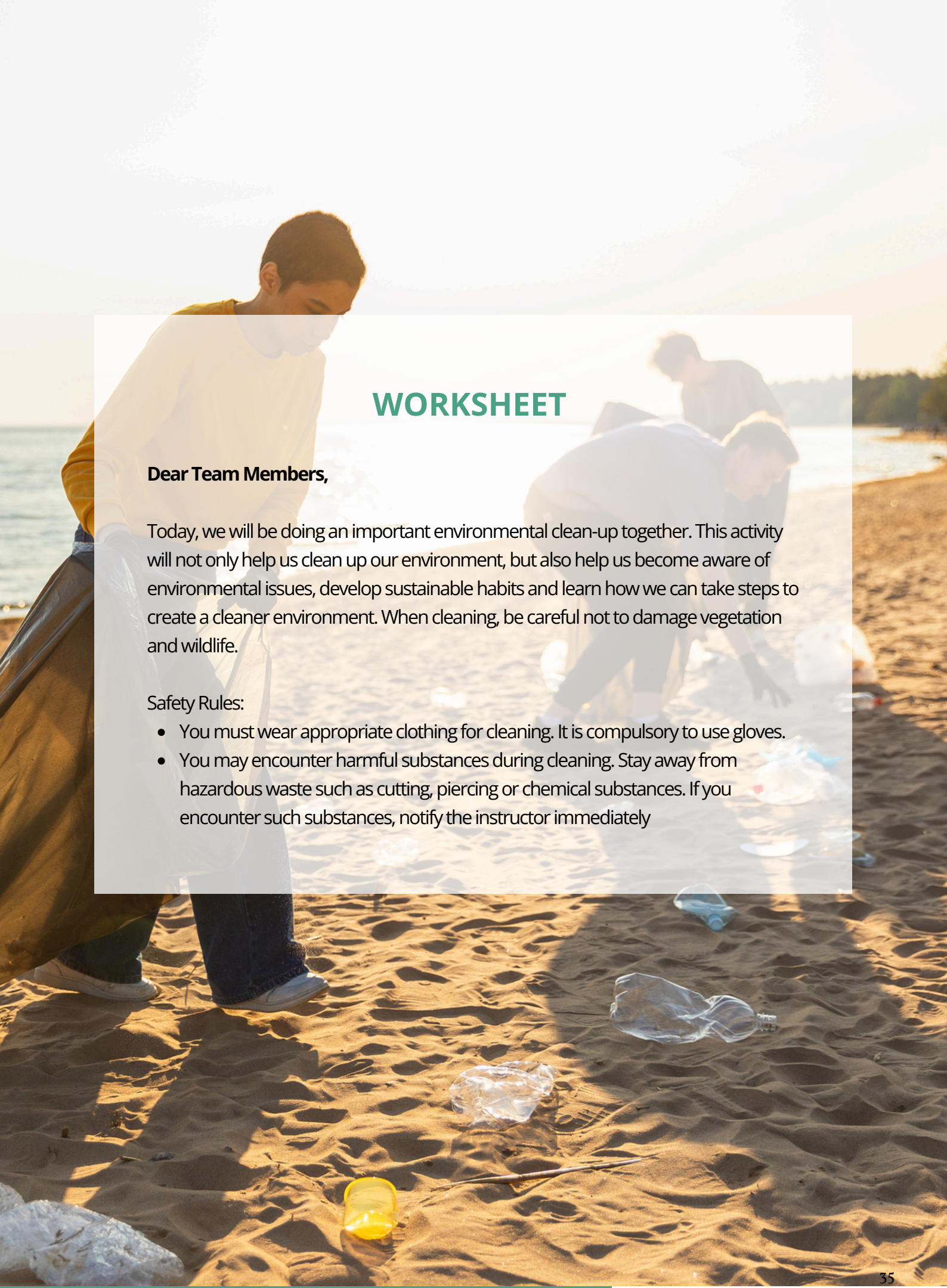
Step 3

Students go to the designated environmental cleaning activity area designated for this activity. Students work in teams to collect garbage and waste in different parts of the area. At this stage, the instructor asks the students "Is what you collected garbage or waste? What are the types of waste? How can these wastes be recycled? What designs can be made using waste?". The instructor observes the students and guides them when necessary. Students answer the questions on the worksheet in line with the number and types of waste they collect (duration: 40 minutes).

Step 4

Students throw the waste they collect into the appropriate recycling bins. The instructor asks "Which types of waste did you encounter in the areas you cleaned? Which color recycling bins did you throw these wastes into? Which type of waste did you encounter the most? Which of these wastes do you think cause more damage to the environment? What impact does environmental pollution have on ecosystem and human health? What can be done to raise awareness about this issue in society?" and a class discussion is held (duration: 20 minutes).



WORKSHEET

Dear Team Members,

Today, we will be doing an important environmental clean-up together. This activity will not only help us clean up our environment, but also help us become aware of environmental issues, develop sustainable habits and learn how we can take steps to create a cleaner environment. When cleaning, be careful not to damage vegetation and wildlife.

Safety Rules:

- You must wear appropriate clothing for cleaning. It is compulsory to use gloves.
- You may encounter harmful substances during cleaning. Stay away from hazardous waste such as cutting, piercing or chemical substances. If you encounter such substances, notify the instructor immediately

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1- During the waste collection activity, it is crucial to properly classify the waste you collect. Correct waste sorting is essential for an efficient recycling process.

Team	Plastic	Paper	Glass	Metal	Organic	Other	Total
TOTAL							

2. How much waste did you collect in total?

3. What types of waste did you collected?

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4- Which type of waste did you collect the most?

5- Which actions can help raise environmental awareness in the society?

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Proje Adı / The Title of The Project
E-STEM ile Çocukların Çevresel Sürdürülebilirlik için Güçlendirilmesi / Empowering Children for Environmental Sustainability through E-STEM

Proje Ortağının Adı / Name of The Project Partner
Uluslararası Kalkınma ve Çevre Derneği – IDEA Universal / International Association for Development and Environment – IDEA Universal

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