UpSpace: Upcycling and Regeneration of Urban Space for Green Skills

Ref. number 2024-1-IT02-KA220-SCH-000249480

Upcycling Booklet for teachers

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Executive Summary

The *Upcycling Booklet for Teachers*, developed within the Erasmus+ project **UpSpace – Upcycling and Regeneration of Urban Space for Green Skills**, provides educators with practical tools and inspiration to integrate sustainability and circular economy principles into classroom learning. By focusing on upcycling as a creative and hands-on approach to resource conservation, the booklet helps teachers foster environmental awareness, critical thinking, and problem-solving skills among students.

The publication introduces the principles of the **6Rs of Sustainability**—Rethink, Refuse, Reduce, Reuse, Repair, and Recycle—and explores waste management challenges and recycling systems in the partner countries Germany, Italy, Greece, and Serbia. It encourages learners to understand sustainability not only as a technical issue but also as a social and environmental responsibility.

A central part of the booklet presents practical upcycling opportunities for a wide range of materials, including wood, textiles, paper, glass, metals, plastics, and food leftovers. Through project ideas, workshop activities, and classroom applications, students are encouraged to transform waste into valuable resources while developing green skills and circular thinking.

By combining environmental education with creativity and international cooperation, the booklet supports schools in promoting sustainable lifestyles and empowering young people to become active contributors to a more resource-efficient and sustainable future.

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Upcycling Booklet for teachers

UpSpace brings schools in 5 countries together through Erasmus+

UpSpace is a European cooperation project funded under the Erasmus+ programme, Key Action 2 (KA220-SCH–Cooperation partnerships in school education), which supports partnerships for innovation and exchange of good practices in the school education sector. It is co-funded by the European Union and coordinated by a consortium of schools and expert organisations from Germany, Greece, Italy and Serbia.

1. Project Introduction – Cross-Country Collaboration for a Cleaner Planet

UpSpace brings teachers and students from five countries together to promote sustainable lifestyles through practical education. A central focus of the project is upcycling: the creative reuse of materials to reduce waste and make the principles of a circular economy tangible.

The **Upcycling Workshop Booklet** provides teachers with a hands-on introduction to upcycling. It contains guidance and ideas for transforming everyday materials—such as plastic, paper, glass, textiles, metal, and wood—into new, functional, or decorative objects. The booklet enables teachers to involve students in innovative, participatory learning experiences and helps embed sustainable thinking into everyday school life.

In workshops and lab sessions, students put these concepts into practice: experimenting with materials, developing problem-solving skills, critical thinking, and creativity, while gaining a clear understanding of the environmental impact of consumption and waste. These activities make sustainable practices tangible, strengthen key competences, and prepare young people to take active roles in their communities and in addressing climate change.

Through the combination of the Upcycling Workshop Booklet and hands-on activities, the project fosters green skills, promotes sustainable habits in schools, and strengthens cross-country collaboration for a cleaner, more resource-conscious future.

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2. The 6Rs of Sustainability – *Rethink Your Relationship with Resources*

The 6Rs – **Rethink, Refuse, Reduce, Reuse, Repair, and Recycle** – provide a practical guide to minimize environmental impact and design products and systems more sustainably. They encourage us to reconsider how we consume, use, and dispose of resources in daily life.

1. Rethink: Start by questioning whether a product is really needed. Could it be redesigned for longer life, easier repair, or better recyclability? Rethinking consumption also includes shifting from ownership to services, like renting tools, sharing vehicles, or subscribing to lighting as a service, which reduces material use while still meeting needs.

2. Refuse: Avoid products or materials that are unnecessary, non-recyclable, or harmful. For instance, skipping single-use plastic packaging, opting out of fast-fashion trends, or refusing to buy electronics with planned obsolescence. Refusing encourages manufacturers to design more responsibly.

3. Reduce: Minimize material and energy use. This could be buying fewer products, choosing concentrated or multipurpose items, or selecting durable alternatives that require less frequent replacement. Reducing reduces both resource extraction and waste generation.

4. Reuse: Extend product life by finding new uses or repurposing items. Examples include refillable bottles, second-hand clothing, and refurbished electronics. Reuse keeps materials circulating longer and prevents them from entering the waste stream prematurely.

5. Repair: Fixing broken products is often more sustainable than replacing them. Repairable and modular designs allow individual parts to be replaced, reducing the need to discard entire items and conserving resources.

6. Recycle: Recycling is the final step when products can no longer be reused or repaired. Products designed for recyclability, such as single-material textiles or easily separable electronics, ensure that materials are effectively recovered and reintegrated into new production cycles.

A holistic example of these principles is the **Cradle-to-Cradle (C2C) approach**, which designs products so that all materials continuously circulate. Materials are classified as **biological nutrients**, safely returning to nature, or **technical nutrients**, circulating indefinitely in industrial loops. This approach embeds circularity at the design stage, ensuring resources are preserved and waste is eliminated.

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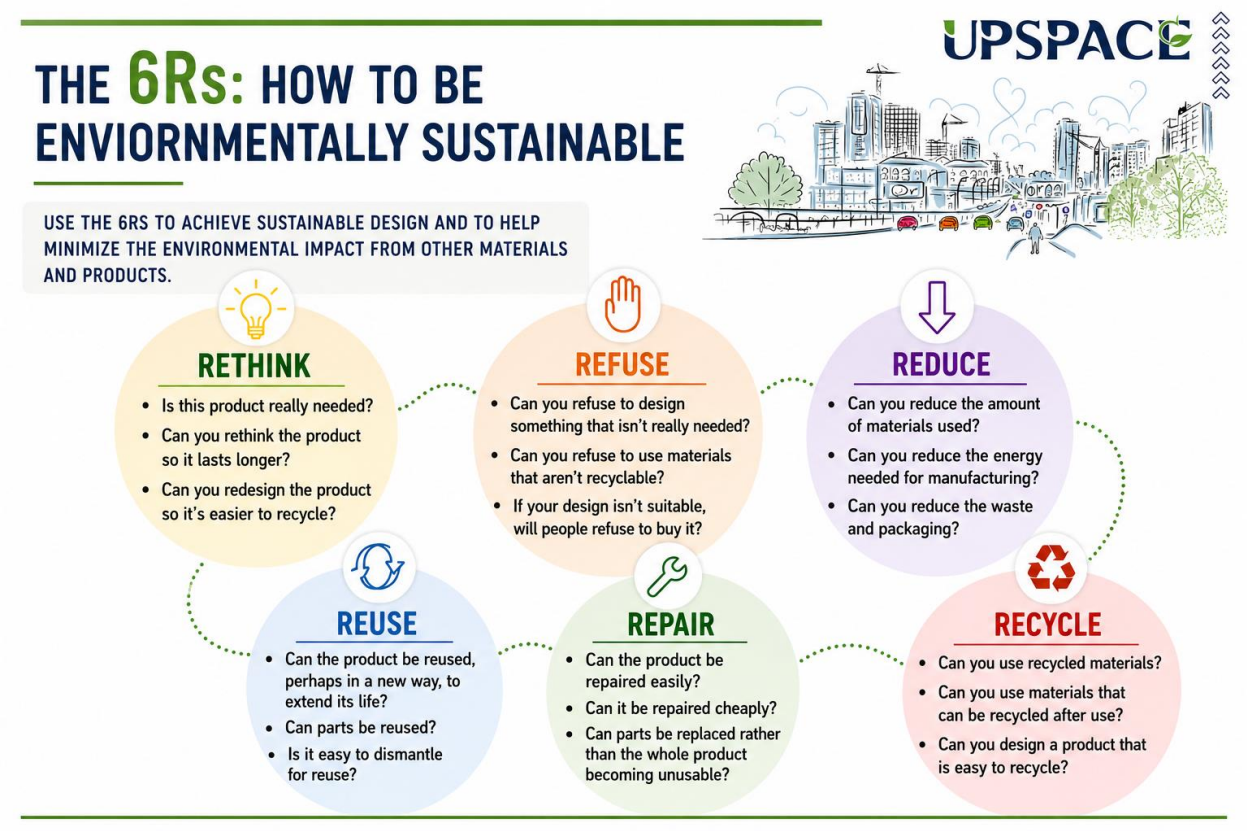
In daily life, following the 6Rs means constantly asking: *Do I need this product? Can it be shared, reused, repaired, or recycled? How can I rethink my choices to minimize environmental impact?* Applying these principles reduces waste, conserves resources, and supports a truly circular economy.



3. Waste & Recycling Systems in Partner Countries – *How Europe Handles Waste: Four Perspectives*

3.1 Introduction: Different Systems, Shared Challenges

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Waste management is a key environmental challenge across Europe. While all partner countries aim to strengthen recycling and move towards a circular economy, they differ considerably in terms of infrastructure, implementation, and environmental performance. Serbia and Greece remain strongly dependent on landfill disposal, whereas Italy and Germany have developed more extensive systems of separate collection and recycling.

However, recycling rates alone provide only a partial picture of sustainability. The effectiveness of waste management systems also depends on political implementation, investment in infrastructure, public participation, and the ability to reduce environmental impacts throughout the entire waste chain. In addition, increasing attention is being paid to broader questions of resource consumption, waste prevention, and environmental justice.

The following sections compare waste management systems in Serbia, Greece, Italy, and Germany. A comparison of household waste separation systems is provided in the following figure.

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3.2 Serbia – Developing Infrastructure and Expanding Recycling

Serbia's waste management system is still undergoing significant development and remains heavily dependent on landfill disposal. Although waste collection services cover most of the population, separate collection systems for recyclable materials are not yet available nationwide, particularly in rural areas. As a result, a large share of municipal waste continues to be disposed of in landfills, while recycling rates remain comparatively low at around 15%.

One of the main challenges is the limited infrastructure for waste separation and recycling, combined with relatively low public awareness regarding waste prevention and proper sorting. In some areas, recyclable materials are still recovered through informal collection systems rather than through organized municipal services.

To address these issues, Serbia adopted the Waste Management Programme 2022–2031, which aims to increase recycling rates, expand separate collection systems, and reduce landfill dependency. These reforms are closely linked to Serbia's broader efforts to align its environmental policies with European Union standards. While progress has been made in recent years through investments in regional waste management centres and recycling facilities, substantial challenges remain regarding implementation, financing, and public participation.

3.3 Greece – Between Circular Economy Policies and Landfill Dependency

Greece has introduced a wide range of reforms intended to modernize its waste management system and promote a transition towards a circular economy. Separate collection systems, recycling centres, bio-waste collection schemes, and extended producer responsibility programmes have expanded considerably over the past decade.

Despite these efforts, Greece remains one of the most landfill-dependent countries in the European Union. More than four-fifths of municipal waste still ends up in landfills, while recycling rates remain relatively low compared to the European average. The main challenge is not the absence of policy frameworks but the persistent gap between political commitments and practical implementation.

This implementation deficit has repeatedly resulted in criticism and legal action from European institutions, particularly regarding illegal landfill sites and failures to meet waste

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management obligations. At the same time, growing investments in sorting facilities, municipal recycling infrastructure, and public awareness campaigns indicate gradual progress.

The Greek case demonstrates that legislative reforms alone are insufficient. Effective waste management requires long-term investment, administrative capacity, and consistent implementation at local and regional levels.

3.4 Italy – High Recycling Rates and Regional Disparities

Italy has developed a well-established waste management system based on separate collection, recycling, and producer responsibility. Municipalities play a central role in organizing collection services, while national recycling consortia support the recovery of packaging and other recyclable materials.

The country has achieved considerable progress over recent decades, reaching a separate collection rate of almost 68% in 2024. This places Italy among the stronger performers within Europe and reflects sustained investment in collection systems, recycling infrastructure, and circular economy policies.

At the same time, significant territorial differences persist. Northern regions generally achieve higher collection and recycling rates than many parts of central and southern Italy, reflecting broader economic and infrastructural disparities. In addition, Italy has faced long-standing environmental challenges related to illegal dumping, insufficient treatment capacity, and weaknesses in local governance, leading to several infringement procedures and financial penalties from the European Union.

Current national strategies increasingly emphasize waste prevention, reuse, recycling, and the development of secondary raw material markets. Italy therefore illustrates both the opportunities and limitations of advanced recycling systems: strong overall performance can coexist with important regional inequalities and unresolved structural challenges.

3.5 Germany – Recycling Success and Global Contradictions

Germany is widely regarded as one of Europe's most advanced waste management systems. Separate collection, producer responsibility schemes, deposit-return systems, and

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modern treatment facilities enable large quantities of waste to be recycled or recovered for energy generation.

However, Germany's waste management model is not without criticism. Despite its recycling infrastructure, the country continues to generate very large quantities of waste, highlighting the limits of a strategy focused primarily on recycling rather than waste prevention and reduced consumption.

A particularly controversial issue concerns waste exports. Significant quantities of plastic and electronic waste are shipped abroad, often to countries with weaker environmental regulations and waste management systems. Investigations have documented cases in which exported waste was dumped illegally, openly burned, or processed under hazardous working conditions in countries such as Malaysia, Indonesia, Turkey, and several African states. Although international agreements and national regulations seek to control these exports, enforcement remains difficult and illegal channels continue to exist.

These practices raise broader questions of environmental justice, as part of the environmental burden generated by German consumption is effectively transferred elsewhere. Germany therefore demonstrates both the strengths and the limitations of recycling-based waste management: high recovery rates do not automatically guarantee sustainable resource use or global environmental responsibility.

3.6 Comparative Conclusion

The comparison of the four partner countries reveals different approaches and levels of development in waste management. Serbia and Greece continue to face major challenges related to landfill dependency and infrastructure development, while Italy and Germany have established more advanced collection and recycling systems. At the same time, even countries with comparatively high recycling rates continue to face significant environmental and political challenges.

The examples show that effective waste management cannot be measured solely by recycling performance. Issues such as regional inequalities, implementation gaps, illegal disposal practices, waste exports, and public participation remain important across Europe. Sustainable waste management therefore requires not only efficient collection and treatment systems but also consistent political commitment and long-term investment.

A challenge shared by all countries is the reduction of overall waste generation. While recycling is an important component of the circular economy, environmental benefits remain limited if waste quantities continue to grow. Germany illustrates this dilemma

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particularly clearly. Despite its highly developed recycling infrastructure, the country generated more than 380 million tonnes of waste in 2023 - part of the environmental burden associated with this consumption is shifted to lower-income countries through waste exports, where inadequate waste management systems can lead to pollution, health risks, and environmental injustice.

At the same time, local initiatives such as the "Zero Waste City" programme in Capannori, Italy, demonstrate how waste prevention, repair, reuse, and pay-as-you-throw systems can significantly reduce residual waste and strengthen local circular economies. More information is available at Zero Waste Europe – Capannori Case Study.

Consequently, future waste policies will need to focus not only on improving recycling systems but also on preventing waste, extending product lifetimes, promoting reuse and repair, and reducing overall resource consumption. These objectives represent a common challenge for all partner countries and for Europe as a whole.

4. Upcycling Practices – *Strengthening Green Skills Through Creative Reuse*

Building on the 6Rs and the insights into national waste systems, this chapter introduces upcycling as a practical way to reinforce green competences in teachers and students. Upcycling encourages creative reuse of everyday objects, reduces consumption, and supports circular economy thinking. Teachers are empowered to guide students in exploring how materials can be reimagined, fostering sustainable behaviors, values, and skills in an engaging and participatory way.

4.1 Wood – *Renewable, Durable, but Not Automatically Sustainable*

Historical Perspective: From Traditional Material to Industrial Resource

Wood has accompanied human societies for thousands of years. Due to its availability, strength, and versatility, it has been used for housing, tools, furniture, and everyday objects across cultures. Traditional craftsmanship was based on careful use of resources: wooden objects were repaired, reused, inherited, and often remained in use for generations.

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With industrialization, wood changed from a locally managed resource into a global commodity. Mechanized forestry, large-scale timber production, and the increasing demand for construction materials transformed forests into economically valuable resources. Today, engineered wood products such as Cross-Laminated Timber (CLT) are promoted as alternatives to carbon-intensive construction materials. However, the sustainability of wood depends strongly on how forests are managed, how long products remain in use, and what happens at the end of their life.

Ecological Considerations: Renewable Does Not Mean Unlimited

Wood is often described as a sustainable material because trees can regrow and wood stores biogenic carbon during its lifetime. When forests are managed responsibly and wood products are used for long periods, they can contribute to climate mitigation.

However, wood consumption also has environmental consequences. Intensive logging can contribute to biodiversity loss, habitat destruction, soil degradation, and the weakening of natural carbon sinks. The global demand for timber, paper, and biomass has increased pressure on forests, particularly in regions where ecosystems and local communities are vulnerable.

Therefore, wood should not simply be considered "green" because it is renewable. Sustainable forestry, protection of old-growth forests, responsible sourcing, and extending the lifespan of wooden products are essential for reducing environmental impacts.

End-of-Life: Reuse Before Recycling

At the end of its first use phase, wood should remain in circulation as long as possible. Reusing and repairing wooden products preserves the energy and resources already invested in the material.

Old furniture, construction wood, and wooden objects can often be repaired, redesigned, or transformed into new products. When direct reuse is no longer possible, wood can be recycled into materials such as particleboard or fiberboard. Composting is possible for untreated wood, although decomposition is slow due to its natural structure.

Landfilling should be avoided whenever possible. Under oxygen-free landfill conditions, decomposing wood can release methane, a greenhouse gas with a much stronger warming effect than carbon dioxide.

Harmful Substances and Safety

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Although natural wood is biodegradable, not all wooden products are environmentally harmless. Treated wood, painted surfaces, varnishes, adhesives, and preservatives may contain chemicals that limit reuse or recycling.

Special care is needed when working with old construction materials, painted furniture, or treated outdoor wood, as these may contain substances that are harmful to human health and ecosystems. Before upcycling, materials should be checked, cleaned safely, and prepared appropriately.

Suggested Upcycling Practices

Wood is highly suitable for creative reuse because of its durability and adaptability. Upcycling projects can demonstrate how valuable materials can remain in use instead of becoming waste.

Examples include:

- transforming old furniture into new designs
- creating shelves, boxes, or storage solutions from leftover wood
- using wooden pallets for garden furniture or classroom projects
- turning small wood pieces into toys, artworks, or educational materials
- repairing and redesigning wooden objects instead of replacing them

In educational settings, working with wood allows students to explore craftsmanship, resource conservation, and the principles of the circular economy through practical activities.

Conclusion

Wood has the potential to be a sustainable material because it is renewable, durable, and capable of storing carbon. However, its sustainability is not automatic. Unsustainable forestry, short product lifespans, and poor waste management can undermine its environmental benefits.
The most sustainable use of wood is not simply choosing wood over other materials, but valuing it as a resource: protecting forests, extending product lifetimes, repairing, reusing, and keeping wood in circulation for as long as possible.

4.2 Textiles – From Waste to Wearable or Functional Materials

Historical Perspective: The Long Life of Textiles

Textiles have always been precious, labor-intensive, and often expensive. The idea of repurposing and transforming fabric is not new. Patchwork, one of the earliest examples of

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textile upcycling, dates back over 3,000 years. The oldest known piece, a funerary cloth made from gazelle hides, comes from Egypt around 1000 BCE. Patchwork spread from the Mediterranean to Europe between the 11th and 13th centuries, influenced by the Crusades.

Initially, patchwork was driven by necessity: hand-spun and handwoven fabrics were valuable, and every usable piece of cloth was preserved. In Sweden, from the early 19th century, rag rugs were woven from leftover fabric scraps. These colorful floor rugs were both functional, providing warmth during winter, and decorative, often reflecting the wealth of a household. They demonstrate how resourcefulness, creativity, and aesthetic expression have long been intertwined in textile reuse.

A Quick Insight into Quilt Techniques

Quilts are a classic example of patchwork's evolution. Historically, they were practical bed covers made from scraps and old garments. Quilts combine a patchwork top with a backing and padding to create warm, durable textiles. Today, quilts often serve as **Artquilts**, designed primarily for display, where creativity and artistic expression take center stage. Techniques include **pieced work** (sewing pieces edge-to-edge) and **appliqué** (layering fabrics with decorative stitching).

Ecological Considerations and Fiber Choices

Natural fibers—such as cotton, linen, hemp, wool, or silk—should be preferred for both upcycling and new purchases because they are biodegradable, more durable and can be recycled. Synthetic fibers (polyester, nylon, acrylic) and blended fabrics should be directed to residual waste rather than upcycling, as their wear contributes to microplastic pollution.

Microplastic Awareness

Synthetics are a major source of microplastics in oceans, contributing roughly 35% of total input. Fibers are released during washing and wear, often bypassing wastewater filtration and entering marine ecosystems. Reducing synthetic use and prioritizing natural fibers is critical for mitigating microplastic pollution.

Synthetic Textile Waste: A Growing Global Injustice

A central but often overlooked aspect of the fast-fashion crisis lies in the severe *end-of-life* implications of the industry's preferred materials—namely synthetic, plastic-based fibres such as polyester, nylon or elastane. Designed for low cost and rapid turnover rather than durability or recyclability, these fibres persist in the environment for decades to centuries once discarded. In many East African countries, where large volumes of unusable Secondhand clothes (called Mitumba) arrive daily, the absence of adequate waste-management infrastructure means these materials accumulate in open dumpsites,

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riverbeds and informal burning areas. As synthetic textiles degrade extremely slowly, they continuously shed microplastic fibres that spread through soil, water and air, entering local food chains and posing long-term risks to human health and ecosystems. At the same time, the chemical additives used during production—such as dyes, flame retardants and finishing agents—can leach out over time, creating a toxic legacy for communities living near disposal sites. The notion of "recycling" synthetic garments remains largely a myth: true fibre-to-fibre recycling is technologically limited, economically unviable at scale, and incompatible with the mixed-fibre blends typical of fast-fashion items. As a result, the Global South is left to absorb the environmental burden of materials that were never designed with a viable end-of-life pathway, underscoring the urgency for global regulation, material redesign, and an immediate reduction in the production of synthetic fast-fashion textiles.

Suggested Upcycling Practices

Upcycling transforms discarded textiles into new, functional, or decorative products, giving them a second life while fostering creativity. Textiles in **excellent condition** are ideal for creating new garments or bags, while those in **worn or damaged condition** are better suited for projects like rag rugs or other utilitarian items. The possibilities are vast, from simple repairs to entirely new designs. Projects can be tailored to the material's condition, texture, and type:

- **Garment transformation:** Resize, reshape, or combine garments into new clothing. Examples include turning oversized shirts into dresses, long-sleeve T-shirts into crop tops, or combining multiple blouses into a patchwork top.
- **Accessories:** Old jeans can become crossbody bags, laptop cases, or patchwork wallets. T-shirts and sweaters can be braided into dog toys or repurposed into scrunchies.
- **Home textiles:** Bed linens or worn clothing can be stitched into cushion covers, quilts, or rag rugs. Creative patchwork allows for playful color combinations and patterns, turning everyday materials into striking pieces.
- **Artistic reinterpretation:** Mix fabrics of different textures or colors for statement jackets, patchwork skirts, or decorative wall quilts. Embellishments like embroidery, appliqués, lace, or fabric paint can add individuality.
- **Mini projects:** Sew gift bags from squares of old shirts, make heatable herb or cherry pit cushions from old pillowcases, or create decorative patches and badges.

Upcycling should focus on **functional or meaningful creations** rather than mere decoration. Materials should be free from harmful substances, and the project's goal should ideally replace the need for new items. By selecting fabrics according to their condition and potential, crafters can balance creativity, durability, and sustainability.

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Conclusion

Textile upcycling demonstrates the value of extending fabric lifecycles, yet it cannot hide the systemic failures of the fast-fashion industry. Cheap, synthetic fibers dominate production, designed for rapid turnover and disposability rather than durability or recyclability. As a result, vast amounts of clothing—especially low-quality second-hand garments exported as Mitumba—end up in dumpsites and rivers in the Global South, releasing microplastics and hazardous chemicals that persist for decades.

While upcycling and careful reuse can mitigate some impacts, the real problem lies in overproduction, reliance on synthetic textiles, and the absence of effective end-of-life solutions. True sustainability requires reducing the creation of disposable garments, prioritizing durable and natural materials, and implementing global regulations to prevent the environmental and social costs of fashion from being exported to vulnerable communities.

4.3 Paper & Cardboard – Recyclable, but Not Without Limits

Historical Perspective: From Valuable Resource to Disposable Product

Paper has played an important role in human communication, education, and cultural development for centuries. Traditionally, paper was a valuable resource that was used carefully and reused whenever possible. With industrial production and mass consumption, paper became an everyday disposable material used for packaging, printing, and hygiene products.

Today, paper and cardboard are among the most widely used materials worldwide. Their recyclability makes them an important part of the circular economy, but increasing consumption continues to create pressure on forests and natural resources.

Ecological Considerations: Recycling Saves Resources, but Reduction Remains Essential

Recycling paper reduces the need for fresh wood fibres and helps protect forests, biodiversity, and natural habitats. Compared to paper made from virgin fibres, recycled paper generally requires less energy and water during production and reduces the demand for new timber.

However, recycling cannot solve the problem of excessive paper consumption alone. Paper production still depends partly on fresh fibres, as paper fibres become shorter and weaker with each recycling cycle. Some products, such as certain food packaging or hygiene papers, require additional fresh fibres due to technical or safety requirements.

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The most sustainable approach is therefore a combination of reducing unnecessary paper use, choosing recycled paper, and keeping paper products in circulation for as long as possible.

End-of-Life Options: Recycling Before Disposal

Paper and cardboard are highly suitable for recycling when they are collected separately and kept clean. Cardboard packaging, newspapers, and office paper can often be processed into new paper products.

However, not all paper products can be recycled easily. Coatings, plastic layers, laminates, adhesives, paints, and chemical treatments can reduce recyclability and may introduce harmful substances into the recycling process.

Composting is possible for untreated paper and cardboard, especially when used as a carbon-rich material in compost systems. Landfilling should be avoided because valuable fibres are lost and organic materials can contribute to greenhouse gas emissions during decomposition.

Suggested Upcycling Practices

Paper and cardboard are accessible materials for creative reuse, especially in educational settings. Upcycling activities can help students understand resource conservation and circular thinking.

Examples include:

- creating notebooks, cards, or gift packaging from used paper
- building models, furniture prototypes, or learning materials from cardboard
- making handmade recycled paper
- transforming cardboard boxes into storage systems or creative artworks
- reusing packaging materials instead of buying new products

These activities demonstrate that paper is not simply waste after one use, but a resource that can remain valuable through creative reuse.

Conclusion

Paper and cardboard are important circular materials because they can be recycled and reused multiple times. However, recycling alone is not enough to address the environmental impacts of paper production. Reducing unnecessary consumption,

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increasing the use of recycled fibres, and extending the lifespan of paper products are essential steps toward protecting forests and using resources responsibly.

4.4 Glass – Infinite Recyclability

Historical Perspective

Glass has been used for more than 4,000 years and has long been valued for its durability and reusability. In traditional European households, bottles and jars were commonly returned, refilled, or repurposed for storage. This long-standing practice makes glass one of the earliest examples of a circular material in everyday life.

Environmental Impact

Glass is produced from natural raw materials such as sand, soda ash, and limestone. It is fully recyclable and can be remelted endlessly without losing quality, which significantly reduces the need for new raw materials. Recycling also saves energy compared to producing new glass, although the melting process still requires high temperatures. For this reason, reusing glass containers directly is even more environmentally friendly than recycling.

End-of-Life Considerations

At the end of its life cycle, glass should ideally be collected and recycled, as this keeps the material in continuous use. When reused at home, jars and bottles can serve many practical purposes before recycling becomes necessary. If disposed of in landfill, glass does not release harmful substances, but it remains unused as a valuable resource.

Harmful Substances and Safety

Glass itself is non-toxic. However, not all glass is equally suitable for recycling or reuse. Items with coatings, paints, or mixed materials can disrupt recycling processes. Special attention should also be given to glass containers previously used for medicines or laboratory substances. These may contain harmful residues and should not be reused for food or everyday purposes. Instead, they must be disposed of through appropriate waste systems to avoid potential health and environmental risks.

Upcycling in Practice

Glass is particularly suitable for simple and practical upcycling. In everyday life, jars can easily be reused for storing food, spices, or small household items, helping to reduce the need for plastic packaging. Bottles can be transformed into decorative or functional objects such as vases, candle holders, or lamps. In gardening, they can serve as small planters or be used in simple irrigation systems for plants.

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In educational settings, students can actively engage with glass reuse by creating their own storage systems, designing decorative objects, or developing "zero-waste" solutions for kitchens and classrooms. These hands-on activities not only encourage creativity but also strengthen awareness of resource conservation and responsible consumption.

Conclusion

Glass stands out as one of the most sustainable materials due to its infinite recyclability and safe composition. However, its full potential can only be realized through proper sorting, conscious reuse, and awareness of previous contents. By integrating glass upcycling into daily habits, individuals can contribute to reducing waste and promoting a more sustainable lifestyle.

4.5 Metals – Strong and Long-Lasting

Historical Perspective

Metals have shaped human civilization for more than 8,000 years, marking entire historical periods such as the Copper Age, Bronze Age, and Iron Age. Early societies used metals for tools, weapons, agriculture, construction, and trade because of their strength, durability, and ability to be reshaped without losing performance. Today, metals such as steel, aluminum, copper, and titanium remain essential in architecture, transportation, energy systems, and technology because they combine mechanical strength with long service life. Their historical importance lies not only in their functionality, but also in their ability to be reused and passed through generations with minimal loss of structural performance.

Environmental Impact

Although metals are highly durable, their extraction and production can create significant environmental pressure. Mining activities may cause habitat destruction, soil erosion, water contamination, and biodiversity loss, while refining and smelting processes require large amounts of energy and generate greenhouse gas emissions. Life cycle assessments show that a major part of the environmental burden of metals comes from purification and refining stages. High-demand industrial metals such as iron and aluminum contribute substantially to global energy use and carbon emissions due to their large-scale production. However, because metal products often last for decades, their long lifespan can offset part of their initial environmental cost when used responsibly.

End-of-Life Options

Metals are among the most recyclable materials in the circular economy. Unlike many materials, metals can often be melted and reprocessed repeatedly without major loss of quality. Steel, aluminum, copper, and other common metals have relatively high recycling potential, helping reduce the need for virgin mining and lowering energy consumption

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compared with primary production. Metals cannot be composted because they are inorganic materials, and landfilling them is considered a waste of valuable resources. The most sustainable end-of-life pathway for metals is collection, sorting, and recycling into new products.

Presence of Harmful Substances

The metal itself is generally stable and does not create pollution. However, some metal products may contain hazardous surface treatments, paints, galvanizing chemicals, or anti-corrosion coatings. Older metal products may include toxic substances such as lead-based paints, chromium coatings, or other heavy metals that can become environmental pollutants if not handled correctly. Modern industry increasingly uses safer alternatives, but responsible disposal and recycling remain essential to prevent contamination from coatings or composite materials attached to metal surfaces.

Suggested Upcycling Uses

Because of their strength and durability, metals are ideal for upcycling and creative reuse. Old metal containers, pipes, cans, tools, or construction materials can be transformed into furniture, garden planters, storage solutions, lighting fixtures, sculptures, or educational projects. Best practices include cleaning surfaces safely, removing hazardous paints when necessary, separating mixed materials before recycling, and choosing repair or reuse before disposal. Extending the life of metal products supports resource efficiency and reduces the environmental impacts linked to mining and manufacturing new materials. This makes metals one of the strongest examples of how durability, reuse, and recycling can support a more sustainable material economy.

Conclusion

Metals represent one of the most valuable materials in the transition toward a more sustainable future. Their exceptional strength, durability, and ability to be recycled repeatedly make them a key resource in both traditional industries and modern circular economies. Although the extraction and processing of metals can place significant pressure on the environment, responsible production, longer product lifespans, repair, reuse, and effective recycling can greatly reduce their overall ecological impact. When managed wisely, metals are not simply materials of the past, they are essential resources for building resilient, innovative, and environmentally responsible communities for the future.

4.6 Plastics – A Useful Material with a Global Cost

Historical Perspective: From Innovation to Disposable Culture

Plastic transformed modern life. Since its industrial expansion in the 20th century, synthetic materials have enabled affordable products, medical technologies, transportation, and

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everyday objects. Their low weight, durability, and flexibility made plastics economically attractive and widely used.

However, the same properties that make plastic useful also create one of today's biggest environmental challenges. A material designed to last for decades is often used only for minutes, especially in packaging and single-use products. The rapid growth of plastic production has created a global waste crisis that cannot be solved by individual recycling efforts alone.

Ecological and Social Impacts: The Problem Begins Before Waste

Plastic is not only a waste issue. Most plastics are produced from fossil resources such as oil and gas, linking plastic production directly to climate change and resource extraction. Along the entire lifecycle—from extraction and production to use and disposal—plastic creates environmental and social impacts.

The global consequences are unequally distributed. While plastic consumption is concentrated in industrialized economies, waste management burdens are often shifted to regions with weaker infrastructure. Plastic waste exports, open dumping, and uncontrolled burning can expose local communities to toxic substances and long-term environmental damage.

A major misconception is that recycling alone can solve the plastic problem. Many plastic products are difficult or impossible to recycle because they contain mixed materials, additives, or poor-quality polymers. As a result, only a limited share of plastic waste is actually transformed into new products.

End-of-Life: Recycling Is Not Enough

Plastic does not biodegrade like organic materials. Instead, it breaks down into smaller fragments, creating microplastics that can persist in ecosystems for long periods.

Recycling can reduce the need for new plastic production, but it has clear limitations. Plastic quality often decreases during recycling, different polymer types require separation, and many products are not designed for circular use. The most effective strategies are therefore prevention, reuse, repair, and reducing unnecessary plastic consumption.

Landfilling and incineration do not create a circular system. They either permanently remove valuable resources from circulation or continue dependence on fossil-based materials.

Harmful Substances and Health Concerns

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Plastic products often contain additives that improve flexibility, durability, colour, or resistance to heat. Some of these chemical substances can pose risks to ecosystems and human health, especially when plastics degrade or enter food chains.

Microplastics have now been detected in many environmental systems, including oceans, soils, and living organisms. The long-term effects of widespread plastic exposure are still being researched, but the scale of contamination demonstrates the need for precaution and stronger regulation.

Suggested Upcycling Practices: Learning Through Critical Reuse

Upcycling plastic can help students understand material properties, consumption patterns, and the importance of extending product lifetimes. However, creative reuse should not create the illusion that plastic waste itself is the solution.

Educational examples include:

- transforming durable plastic containers into storage systems
- repairing and extending the life of plastic products
- creating design projects that explore alternative uses of existing materials
- analysing everyday plastic consumption and developing reduction strategies
- comparing reusable alternatives to single-use products

The most important learning goal is not to create more objects from plastic waste, but to question why so much disposable plastic is produced in the first place.

Conclusion

Plastic is a material with valuable applications, but its current production and consumption model is unsustainable. The global plastic crisis is driven less by individual behaviour and more by a system based on increasing production, short product lifetimes, and disposable consumption.

Real solutions require political action, corporate responsibility, reduced production of unnecessary plastics, and a transition toward reusable and circular systems. Upcycling can support awareness and creativity, but it must be part of a broader transformation: moving from a culture of disposal toward a culture of prevention, reuse, and responsibility.

4.7 Culinary Upcycling – Transforming Food Leftovers into Traditional Dishes

Food waste is a major environmental challenge. Producing food requires land, water, energy, and human labour, meaning that wasted food also represents wasted resources. Across Europe, many traditional recipes developed from the need to use available

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ingredients carefully and avoid unnecessary waste. These practices show that sustainability is not only about materials such as wood, textiles, or plastics, but also about everyday choices in the kitchen.

Culinary upcycling connects traditional knowledge with modern sustainability education. By exploring regional dishes made from leftovers, students can discover how creativity, resourcefulness, and respect for food can contribute to reducing waste.

Giving Bread a Second Life: Traditional German Dishes

In Germany, stale bread has long been reused in everyday cooking. A well-known example is **Semmelknödel**, made from dried bread rolls mixed with milk, eggs, onions, and parsley, then shaped into dumplings and cooked. Other traditional examples include **Arme Ritter** and bread pudding, which transform old bread into sweet dishes.

These recipes show how simple leftovers can become nutritious meals instead of being discarded.

Popara: A Serbian Tradition of using leftovers

In Serbia, **Popara** is a traditional dish made from stale bread. The bread is broken into pieces, combined with hot water or milk, and cooked until it reaches a soft texture. Butter, oil, or white cheese can be added depending on available ingredients.

Popara demonstrates how basic leftovers can be transformed into a simple, comforting meal.

Gemista: A Greek Tradition of Using Available Ingredients

Greek cuisine has a long tradition of making the most of available resources. **Gemista** is a popular dish in which tomatoes and peppers are filled with rice, herbs, onions, and other ingredients available at home, including leftover rice or vegetables.

The filled vegetables are slowly baked in the oven, creating a nutritious meal from simple ingredients that might otherwise go unused.

Arancine: Transforming Leftover Rice into a Sicilian Speciality

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In Sicily, **Arancine** are a traditional example of turning leftovers into a valued dish. Originally, leftover cooked rice was shaped into balls, filled with ingredients such as ragù, cheese, or peas, coated with breadcrumbs, and fried.

Today, arancine are a famous regional speciality and demonstrate how leftover ingredients can become culturally meaningful food.

Conclusion

These examples from different European regions show that culinary upcycling is not a new idea but a practice rooted in cultural traditions. Whether using stale bread, leftover rice, or available vegetables, these dishes demonstrate that food can remain valuable beyond its first use.

Combining traditional knowledge with modern sustainability education helps students understand the importance of reducing food waste, valuing resources, and developing creative solutions for a more sustainable future.

5. Teaching Practice: Upcycling Activities and Workshop Ideas

Practice Example 1: Upcycling Old Clothing into Useful New Products

Topic	**Textile Upcycling and Sustainable Consumption**
Age Group	12–16 years
Duration	One project day (approx. 5–6 hours)
Learning Objectives	Understand the impacts of fast fashion; learn about reuse, repair and upcycling; develop creativity and practical skills; reflect on consumption habits
Materials	Old T-shirts and unwanted clothing, scissors, needles and thread, sewing machines (optional), decorative materials

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Activity Description

Step 1: Introduction to Fast Fashion (60 min)
Start with a discussion about clothing consumption and fast fashion. Ask students how many T-shirts they own and where clothes come from. Introduce the environmental impacts of textile production and waste through short videos and guided discussion.

Step 2: Exploring Textile Materials (60 min)
Students investigate different textile fibres (e.g. cotton, polyester, wool, linen) and learn about their production processes and environmental impacts. Small group work and short presentations encourage collaborative learning.

Step 3: Creative Upcycling Workshop (2.5–3 hours)
Students bring old clothing from home and create new products. A simple starting activity is transforming an old T-shirt into a cushion using a knotting technique. Afterwards, students develop their own ideas and work individually or in groups to repair, redesign, or repurpose textiles.

Step 4: Reflection and Presentation (45–60 min)
Participants present their creations and discuss how upcycling contributes to waste reduction and more sustainable lifestyles. The activity can conclude with a small exhibition for other students, teachers, or parents.

Expected Outcomes

- Increased awareness of textile waste and fast fashion
- Practical experience with reuse and repair
- Development of creativity and problem-solving skills
- Creation of useful upcycled products from discarded materials

Photos from the German Pilot Workshop “New Ideas from Old Fabrics”

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6. Classroom Implementation – *Bringing Upcycling into Teaching*

Upcycling offers practical ways to connect sustainability with creativity and everyday learning. It allows students to explore materials, question consumption habits, and develop solutions through hands-on activities.

Possible approaches include:

- **Workshops:** Students transform discarded materials into useful or creative products while learning about material properties and waste reduction.
- **Group projects:** Teams develop upcycling ideas, research the environmental impact of materials, and present their solutions.
- **Project weeks:** Upcycling can be combined with design, crafts, science, or environmental topics in larger interdisciplinary projects.
- **Reflection activities:** Discussions, learning journals, or presentations help students connect practical work with sustainability challenges.
- **Cross-curricular learning:** Upcycling can be integrated into subjects such as art and design (creative transformation), science (materials and environmental impacts), technology (repair and construction), or social studies (consumption and global responsibility).

The goal is not only to create new objects but to encourage students to think critically about resources, waste, and their own role in a circular economy.

7. Final Thoughts – *Empowering the Next Generation of Changemakers*

Upcycling shows that sustainability can begin with simple everyday actions. By reusing materials creatively, students learn to value resources, reduce waste, and develop practical solutions for environmental challenges.
The examples in this booklet demonstrate that sustainable practices are connected to culture, creativity, and cooperation across countries. Through international exchange, teachers and students can discover different perspectives and learn from each other's approaches.
Upcycling activities can continue beyond this project—through classroom experiments, school initiatives, and everyday choices. By empowering students to become creative thinkers and responsible citizens, education can contribute to a more sustainable future.

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