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**From Trash to a Career:**

**Using Post-Consumed Plastic to Spark Critical Thinking in Today's Sustainability-minded  
Students**

#4, Session I

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**Scholarly Abstract:**

In a world increasingly focused on sustainability, the challenge of plastic waste presents both a significant environmental problem and an opportunity for innovation. High-Density Polyethylene (HDPE), a common and durable plastic found in everyday items like bottles, pipes, and containers, is a major contributor to global plastic waste. This paper explores how recycling HDPE can be leveraged not just as an environmental solution but as an educational tool that inspires the next generation of sustainability leaders.

The process of recycling post-consumed HDPE involves transforming waste materials into valuable resources, which reduces the demand for virgin plastics and minimizes environmental impact. However, the current recycling rates for HDPE are far from optimal, hindered by issues such as contamination, inadequate infrastructure, and market challenges. These obstacles offer rich learning opportunities for students to engage in critical thinking, problem-solving, and innovative design.

This paper will examine how integrating HDPE recycling into educational curricula can empower students to tackle real-world sustainability challenges. By analyzing the technical, economic, and social aspects of HDPE recycling, students can better understand the complexities involved in creating sustainable systems. Hands-on projects, such as designing products from recycled HDPE or developing campaigns to improve recycling rates, provide practical experience that bridges the gap between theory and practice.

Moreover, the paper will highlight how careers in recycling and sustainability are growing fields with significant potential for impact. By exposing students to the possibilities within the recycling industry, educators can inspire them to pursue careers that contribute to a circular economy. Whether as engineers, environmental scientists, or policymakers, students can be part of the solution to the plastic waste problem, turning what was once considered trash into the foundation of a sustainable career.

Overall, recycling HDPE offers more than just environmental benefits; it is a powerful educational tool that ignites students' passion for sustainability. This paper aims to show how using post-consumed plastic in the classroom can foster critical thinking and prepare students for meaningful careers that address today's most pressing environmental challenges. By transforming trash into opportunity, we can inspire tomorrow's sustainability leaders.

**Key words:** sustainability, high-density polyethylene (HDPE), plastic waste management, recycling, experiential learning, career opportunities

## Introduction

### Context of Sustainability in Education

In recent years, sustainability has become a central focus in education as global attention shifts toward environmental stewardship and the urgent need for solutions to pressing ecological problems. The surge in awareness around issues such as climate change, resource depletion, and pollution has led to growing concern about the sustainability of modern human activity. One of the most significant challenges in this space is the management of plastic waste, which threatens ecosystems and human health alike. This paper explores how High-Density Polyethylene (HDPE), a prevalent form of plastic, can be used not only to address environmental issues but also to cultivate critical thinking skills among students who are the future leaders of sustainability efforts.

### Literature Review

This review examines the potential for post-consumed plastics to play a transformative role in education, specifically within the framework of sustainability education. With an increasing volume of plastic waste in oceans and landfills, recycling and repurposing this material offers a unique educational opportunity to cultivate critical thinking, problem-solving, and career-ready skills. Plastic pollution, estimated to contribute to nearly 8 million metric tons annually in marine environments alone, represents an ecological crisis that can drive both awareness and engagement in students when integrated into academic settings (Geyer et al., 2017; Jambeck et al., 2015).

Current research emphasizes the educational potential of involving students in hands-on recycling processes to understand both the complexities and the possibilities within waste management and sustainability sectors. Reduce, Reuse, and Recycle campaigns have been around for decades but do students really get the message? Showing students a way to really recycle is the cornerstone of sustainability. Projects centered around recycling high-density polyethylene (HDPE), a common plastic used in household products, are particularly effective as they engage students with a material readily available and often disposed of in daily life. The mechanical recycling of HDPE not only teaches students about polymers and material science but also introduces them to closed-loop systems and sustainable practices critical for the circular economy (Al-Salem et al., 2020).

Engaging students in the recycling process fosters critical thinking by requiring them to assess the economic and environmental viability of recycling methods, such as mechanical processing. Through this experience, students gain insight into the impact of plastic waste, its degradation into microplastics, and the broader consequences on ecosystems, while developing practical skills in sorting, processing, and upcycling materials (Watt et al., 2021). Such educational approaches align with sustainability education goals by promoting awareness of environmental impact and empowering students to envision careers in fields related to green technologies, waste management, and materials innovation (Alabi et al., 2019; Adelodun, 2021).

Utilizing post-consumed plastic as a teaching tool offers a dual benefit: it provides an environmentally focused education framework that builds awareness of global plastic issues, while also encouraging students to consider sustainability-driven careers. This approach not only nurtures informed and engaged citizens but also prepares them to tackle real-world challenges within the evolving landscape of sustainable development.

### **High-Density Polyethylene (HDPE) as a Case Study**

HDPE is a durable and widely used plastic found in products ranging from milk jugs to grocery bags to detergent bottles. It has a high strength-to-density ratio. A 60-gram HDPE container can easily carry eight pounds of weight. It is malleable, resists environmental factors, and is easily recycled (Piedmont Plastics, 2021). It is one of the most common plastics in circulation, but HDPE plays a significant role in the global plastic waste problem. According to research, HDPE constitutes a major portion of municipal solid waste, contributing to the growing burden of non-biodegradable materials in landfills and oceans. Plastic waste, including HDPE, is particularly problematic due to its resistance to degradation, exacerbating environmental pollution. This adds to the global burden of plastic waste that is difficult to manage in a sustainable way (Ghatge et al., 2020). Despite its durability and recyclability, the recycling rates of HDPE remain low, with much of the material either incinerated or left to degrade slowly over centuries (Andrady, 2011).

### **Purpose of the Paper**

This paper explores how the recycling of post-consumed HDPE can be used as an educational tool to engage students with real-world sustainability challenges. By integrating recycling processes into the classroom, educators can create opportunities for students to develop critical thinking, problem-solving, and innovation skills. In addition, exposing students to HDPE recycling provides an avenue for them to explore careers in the growing fields of sustainability and recycling, helping them turn today's waste problems into tomorrow's career opportunities. The rationale behind this project was twofold. First, as educators, there is an emphasis on the importance of addressing environmental issues and balancing the extraction of raw materials to advance society with the responsible disposal of waste. While educators advocate for sustainable waste management, do they truly practice what they preach? Educators should be leading by example, yet in reality, most do not. Secondly, while researching ways to incorporate a new commercially made and purchased accessory into an existing project, it was revealed that this accessory could be constructed with the use of common household waste, i.e. HDPE, thereby transforming waste into a valuable resource.

## **The Environmental Impact of HDPE**

### **Plastic Waste and HDPE's Role**

Plastic waste, particularly HDPE, poses significant environmental risks. HDPE is everywhere, largely because of its versatility, lightweight nature, and resistance to chemicals. These characteristics make it valuable for packaging, construction, and consumer goods, yet they also

contribute to its environmental persistence (Hopewell et al., 2009). HDPE products, especially single-use items like plastic bottles and packaging, often end up in landfills or oceans, where they can persist for hundreds of years without degrading. The accumulation of plastic waste leads to significant ecological damage, including the disruption of marine and terrestrial ecosystems (Thompson et al., 2009).

### **Recycling HDPE: Benefits and Challenges**

Recycling HDPE offers several environmental benefits, primarily through the reduction of virgin plastic production. Recycling reduces greenhouse gas emissions, saves energy, and conserves natural resources (Geyer et al., 2017). However, the recycling process faces numerous challenges, such as contamination of recyclable materials, inadequate recycling infrastructure, and fluctuating market demand for recycled plastics. HDPE recycling systems are often hampered by improper sorting, which results in contamination that can render large batches of recyclable materials unusable (Geyer et al., 2017). The low recycling rates of HDPE, combined with the growing production of plastic, create a demand for innovative solutions.

### **Recycling as a Learning Opportunity**

The challenges associated with recycling HDPE present valuable learning opportunities. Students can engage in critical thinking and problem-solving activities by analyzing these obstacles. By studying the factors that impede effective recycling—such as contamination and economic feasibility—students can develop creative solutions to improve the recycling process. This hands-on engagement with real-world problems can foster innovation and sustainability-minded thinking.

## **Educational Integration of HDPE Recycling**

### **Embedding Sustainability in the Curriculum**

Incorporating HDPE recycling into educational curricula allows students to confront sustainability challenges directly. Educators can use HDPE as a case study to teach about the environmental impact of plastic waste, the mechanics of recycling, and the potential for innovation in waste management. This approach embeds sustainability into the learning process, making it a central theme of students' education.

As work in plastic processing progressed, an exploration began into how this subject could be effectively integrated into middle and high school curricula. Currently, plastic processes are not adequately covered in existing educational programs. Observations from both student and educator perspectives reveal that concepts related to plastics and recycling are seldom addressed in classroom lessons. For example, while many science classes touch on polymers, few educational programs address the technological or ecological aspects of plastic processing in depth, leaving a gap in hands-on learning about plastic recycling and its environmental

consequences. The Florida Sea Grant Program and other educational initiatives have begun introducing resources that explore microplastics, plastic pollution, and sustainable materials to engage students in understanding these issues more deeply, yet such programs remain relatively rare in formal curricula (IFAS Communications, 2024; *The Plasticsphere: Plastic Migration and Its Impacts - Lesson*, 2018). Expanding these efforts into mainstream science and technology classes could provide students with valuable, applied knowledge on environmental stewardship and sustainable practices related to plastics.

Although students are often taught the mantra "reduce, reuse, recycle," does society truly recycle plastic? Investigating the fate of recycled plastic would make for an excellent research project. In reality, much of the plastic ends up in landfills, is shipped to regional centers, or exported overseas, particularly to Asia, where it contributes to significant environmental challenges due to a lack of recycling infrastructure (Brooks et al., 2018). Rather than sending these materials abroad, they could be reprocessed and repurposed domestically.

While recycled paper products are commonly referenced in society today, products made from recycled plastic are far less visible, which presents numerous educational opportunities. Lessons could cover topics such as plastic production, material composition, and the difficulties faced in managing plastic waste, as well as exploring alternatives to traditional plastics.

By employing methods of recycling and repurposing plastic, students would engage with a versatile material. Since plastic shares many properties with wood, technology departments would not need to invest in new equipment. Students would simply find a way to heat the plastic to a molten state. This could be achieved with a small convection oven, a sandwich press, or a conventional kitchen oven. After the melting and molding process, standard woodworking tools work effectively with HDPE, allowing plastic projects to be seamlessly incorporated into existing woodworking programs.

### **Technical, Economic, and Social Aspects**

By analyzing HDPE recycling from multiple perspectives, students can gain a comprehensive understanding of the complexities involved in sustainability efforts. For example, the technical challenges of sorting and processing HDPE, the economic factors that affect the viability of recycling markets, and the social aspects of consumer behavior all play critical roles in the recycling ecosystem (Hopewell et al., 2009). Educators can guide students through these various dimensions, encouraging them to think holistically about the sustainability challenges that modern society faces.

### **Hands-on Learning Experiences**

One of the most effective ways to teach sustainability is through experiential learning. By engaging in hands-on projects, such as designing new products from recycled HDPE or developing campaigns to promote recycling in their communities, students can apply theoretical

knowledge in practical settings. These projects provide opportunities for students to work on real-world sustainability initiatives, fostering skills in critical thinking, teamwork, and problem-solving (Sterling, 2012). Furthermore, these projects help bridge the gap between abstract environmental concepts and concrete action.

Proper safety protocols are essential when recycling or processing HDPE due to the high temperatures involved. HDPE typically melts between 248°F (120°C) and 356°F (180°C), with processing commonly conducted around 300°F (149°C). Experimental work suggests that heating HDPE to around 310–315°F in a household oven is adequate for workability without exceeding safe limits. However, at these temperatures, molten HDPE can easily adhere to the skin, posing a risk of severe burns. Students should wear heat-resistant gloves, such as high-temperature silicone gloves, to protect themselves (Russell, 2024).

Additionally, heating HDPE beyond recommended levels can release toxic fumes, making proper ventilation essential. To reduce the risk of exposure to harmful vapors, it is crucial to install exhaust systems and monitor processing temperatures carefully. Polyethylene dust or fumes can cause eye irritation, so individuals working around HDPE manufacturing or recycling should use appropriate protective gear to prevent accidental exposure (sschanke\_51w0yw3f, 2016).

This hands-on experience, combined with an emphasis on safety, can enhance students' technical skills and awareness of workplace hazards, further preparing them for future careers in sustainability.

## **Career Opportunities in Recycling and Sustainability**

### **Growth of the Sustainability Sector**

The field of sustainability is expanding rapidly as industries, governments, and organizations recognize the need to reduce their environmental impact. Recycling, waste management, and sustainable design are growing sectors that require innovative solutions to address the global waste crisis. According to the U.S. Bureau of Labor Statistics, jobs in environmental science and protection are projected to grow faster than the average for all occupations, with particular demand in areas related to waste reduction and sustainability (Bureau of Labor Statistics, 2022).

### **Career Opportunities Across Industries**

Students who develop expertise in HDPE recycling and sustainability can find career opportunities in various industries, including engineering, environmental science, policymaking, and corporate sustainability (Sterling, 2012).

Engineers play a crucial role in enhancing recycling efficiency by developing innovative technologies. Key positions in this field include Environmental Engineers, Materials Scientists,

and Industrial Ecologists, all of whom contribute to creating more effective recycling processes and materials management strategies.

Environmental scientists also have an essential role, conducting research to assess the impacts of plastic waste and identifying strategies to minimize its environmental footprint. Relevant job titles in this area encompass Sustainability Consultants, Recycling Coordinators, and Environmental Educators or Outreach Specialists, who work to raise awareness and promote sustainable practices within communities.

Policymakers are also vital to advancing recycling initiatives by advocating for stronger regulations and incentives that support recycling efforts. This group includes Environmental Policy Analysts, Sustainability Consultants, and Corporate Social Responsibility (CSR) Managers, who influence corporate practices and public policy to enhance sustainability measures.

Together, these roles contribute significantly to improving recycling systems, reducing waste, and promoting a sustainable future.

### **Inspiring the Next Generation of Sustainability Leaders**

By integrating HDPE recycling into educational curricula, educators can inspire students to pursue careers in sustainability. When students understand the potential impact of their work on the environment and society, they are more likely to choose careers that contribute to solving pressing global challenges (Sterling, 2012). Whether they become engineers, scientists, or policymakers, students with a foundation in sustainability can play a vital role in creating a circular economy.

## **Transforming Trash into Opportunity**

### **HDPE as a Vehicle for Critical Thinking**

The process of recycling HDPE offers a powerful educational tool for developing critical thinking skills. Students must analyze the challenges associated with recycling, such as contamination and market fluctuations, and develop creative solutions. This type of problem-solving fosters a mindset of innovation and adaptability, which is essential for addressing sustainability challenges in the 21st century (Browne et al., 2011).

### **Long-Term Impact on Students' Career Choices**

Engaging with HDPE recycling allows students to delve into various sustainability sectors, offering them a practical lens through which to understand environmental challenges. This hands-on experience not only equips them with technical skills, such as material processing and waste management, but also fosters soft skills like teamwork, critical thinking, and problem-



solving. As students address real-world issues, they become more aware of the interconnectedness of their choices and their impacts on the environment, inspiring them to pursue careers that prioritize sustainability and innovation. This foundational knowledge can lead to a lifelong commitment to environmental stewardship, ensuring that future leaders are well-prepared to tackle pressing global challenges.

### **Empowering Students to Create Sustainable Systems**

Educators have a unique opportunity to shape the next generation of sustainability leaders by integrating HDPE recycling into their curricula. This approach not only raises awareness about the environmental impact of plastic waste but also fosters critical thinking and problem-solving skills. By encouraging students to devise innovative solutions to real-world environmental challenges, educators empower them to create sustainable systems that can benefit society for years to come (Sterling, 2012). This experiential learning cultivates a sense of agency and responsibility, inspiring students to contribute actively to a more sustainable future.

## **Conclusion**

### **A Pathway from Plastic Waste to Educational and Career Opportunities**

Recycling HDPE plastic is far more than an environmental solution; it is an educational tool that transforms waste into opportunity, offering students hands-on engagement with real-world sustainability challenges. Through the process of HDPE recycling, students develop critical thinking, problem-solving, and innovative skills—qualities essential for addressing complex environmental issues in the 21st century. By integrating these practices into curricula, educators create a learning environment that emphasizes the importance of sustainability, while also preparing students for the growing career fields in recycling, environmental science, and sustainable design.

Beyond simply managing plastic waste, this educational approach equips students with the knowledge to understand the broader implications of sustainability and waste reduction. Students gain insights into the technical, economic, and social dimensions of recycling, empowering them to think holistically about the challenges of sustainability. Moreover, by engaging students in hands-on projects that repurpose HDPE, educators can foster students' creativity and give them the tools to become leaders in a circular economy—an economy in which waste is minimized, and resources are used efficiently.

Ultimately, embedding HDPE recycling into education does more than contribute to reducing plastic waste. It inspires the next generation to pursue meaningful careers that drive sustainable solutions for the future. By turning today's plastic problems into tomorrow's opportunities, educators not only tackle pressing environmental issues but also ignite a passion for innovation and responsibility that will shape the world for years to come.

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