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Low-Cost Separation of PET, PP, and PE Microplastics via Brine-Oil Density-Gradient Centrifugation

Nahum Kim and Seyoon Kim
Urban International High School
Toronto, ON, Canada
akisdokis1342@gmail.com , eddiekim0733@gmail.com

Seo Won Yi
Department of Computer Science
Department of Statistics
University of Toronto
Toronto, ON, Canada
sean.yi@mail.utoronto.ca

Abstract

Microplastic contamination is an escalating global concern, yet existing isolation protocols remain slow, expensive, and reliant on hazardous chemicals. We present a $200 DIY centrifuge method that employs a three-tier brine–sample–oil column to separate microplastics quickly and safely. Twenty fragments each of polyethylene terephthalate (PET), polypropylene (PP), and polyethylene (PE) with diameters of 100-400 µm were spiked into different matrices and spun at 412 ± 25 rpm for 20 minutes. The saturated NaCl layer functions as a density buffer, electrostatic screen, and viscous damper, while oleophilic adhesion traps particles at the oil–brine interface. Mean recoveries reached at most 93% for PET and 99% for PP, and 100% for PE. Because all reagents are food-grade and key parts are 3D printed, the protocol aligns with green-chemistry principles and is affordable for classrooms, laboratories, and field stations. Current limitations include imprecise fraction-collection tools, suboptimal centrifugal force, and limited validation in the variation of matrices. Planned upgrades such as narrow-bore collectors, low-cost imaging, tunable brines, and a faster centrifuge will enable rigorous mass-balance studies and extension to complex matrices such as urine, whole blood, and placenta. This work lays the groundwork for an accessible, non-toxic, and scalable platform for environmental and biomedical microplastic surveillance.

Keywords
Microplastics, Green Chemistry, DIY Centrifuge, Low-cost engineering, Oil-Based Density Separation

1. Introduction

Microplastics are a major global issue that poses significant threats to the environment, animals, and human health. These tiny plastic particles, typically less than 5 mm in size, have been detected across the land, sea, and air, spreading throughout the food chain and even infiltrating the human body (World Economic Forum, 2025). Each year, an estimated 12 million metric tons of plastic enter the ocean, where they gradually break down into microplastics and nanoplastics, fragments that are less visible but far more dangerous to marine ecosystems (Jambeck et al., 2015). Marine organisms often mistake these particles for food, leading to intestinal blockages, poor nutrient absorption, and in some cases, death. Beyond harming marine life, microplastics can also contribute to climate change. They reduce the albedo effect in polar regions, accelerate ice melt, and release more greenhouse gases than larger plastic debris (Li et al., 2024).

On land, microplastics have been found in freshwater sources, soil, and even the air we breathe. As a result, humans are consistently exposed to microplastics through food, water, air, and everyday personal care products. Alarmingly, researchers have identified microplastic particles in vital areas of the human body, including the blood, saliva, liver, kidneys, lungs, gastrointestinal tract, and placenta (Harvard Medical School, 2024). Emerging studies also suggest a link between microplastic exposure and cardiovascular problems, showing that the smaller the particles, the greater the risk of heart attacks in people with pre-existing heart conditions (Marfella et al., 2024). Even more concerning are the impacts during pregnancy. Microplastics have been detected in umbilical cord blood and amniotic fluid, with recent evidence linking them to neurodevelopment disorders in children born to mothers who used microplastic-containing personal care products (Panneerselvam et al., 2025). With projections indicating that microplastic pollution could reach 13.2 billion tons by 2050, the long-term consequences for ecosystems and future generations are becoming increasingly urgent (Irfan et al., 2025).

Detecting microplastics in environmental and biological samples encompasses several general challenges, as they vary in shape, size, and polymer composition, illustrating difficulty in consistent isolation. The majority of detection methods are also time-consuming, require expensive equipment, and often cannot identify particles smaller than 10 micrometres (Ivleva, 2021). Moreover, the process of preparing samples for analysis, such as filtration, drying, and chemical treatment, can lead to contamination, loss of particles, and the use of biohazardous substances (Prata et al., 2019). Such steps also extend processing time significantly, resulting in a significant delay when retrieving large amounts of samples, and nearly impossible to conduct experiments in low-resource settings. One of the major methods to detect microplastics is using spectroscopy. However, this approach has several limitations. If the equipment has to be purchased, machines like FTIR or Raman spectrometers typically cost between 10,000 USD and 40,000 USD. Even the smaller, handheld FTIR devices range from 3,000 USD to 5,000 USD (Prata et al., 2019). In terms of time, spectroscopy is also highly inefficient, depending on the number of particles; analyzing 20 microplastic samples can take between 40 minutes and 2 hours. In some cases, when large volumes or environmental samples are involved, the entire process can take over 24 hours (Shim et al., 2017). These methods also struggle with nanoplastics and MPs under 10 µm without coupling with advanced microscopy tools (Ivleva, 2021).

In contrast, our method offers a low-cost, low-toxicity alternative for rapid MP separation. Unlike spectroscopy-based approaches, our centrifuge system does not rely on expensive instrumentation or require harmful chemical pre-treatments. Instead, it physically separates MPs using differences in density and phase interaction, particularly by incorporating non-toxic oils and liquid phases that can help isolate MPs efficiently and safely. This method reduces contamination risk, minimizes sample preparation time, and remains accessible to low-resource environments.

1.1 Introduction to Our Method

To address the issue of microplastic contamination, our team developed a low-cost centrifuge system that efficiently separates microplastics from liquid samples using density-based methods. Our method specifically targets three of the most common plastic types: polyethylene terephthalate (PET), polyethylene (PE), and polypropylene (PP). Centrifugation is a proven technique for MP separation, with studies demonstrating its success in isolating plastics based on density differences when combined with aqueous separation medium (Pfohl et al., 2024). Our DIY centrifuge, built for 200 USD, uses a DC 775 motor operating at 412 rpm, a safe yet effective solution. The entire process, from setup to recovery, is completed in under 30 minutes, with recovery rates of around 90% for PET and nearly 100% for PE and PP when suspended in a simple matrix such as distilled water, illustrating both speed and effectiveness for practical applications.

In an attempt to enhance separation efficiency without the use of harmful chemicals, an oil-based extractions step using household canola oil was incorporated. This method exploits the hydrophobic and low-density nature of most microplastics, allowing particles to accumulate at the oil-water interface for easy collection (Rani et al., 2023).

Research has proved that oils can recover various plastic types effectively and without polymer degradation (Lechthaler et al., 2020). Unlike traditional approaches such as FTIR or Raman spectroscopy, which cost 10,000-40,000 USD and often require toxic reagents during sample preparation (Prata et al., 2019), our method is non-toxic, affordable, and portable. The combination of centrifugation and oil-phase separation provides a safe, low-cost, and reliable alternative for MP recovery, especially in classrooms, field studies, and labs with limited resources.

1.2 Cost Efficiency and Accessibility

A significant advantage of our method is its affordability. It was designed to use easily obtainable components; the total cost of assembling the centrifuge, including the Arduino, the motor, the motor driver, and the power supply from Amazon, is approximately 200 USD. Moreover, essential parts such as the rotor, tube holders, and caps were fabricated using 3D printing technology, dramatically lowering the overall expenses. With the widespread availability of 3D printers in schools, labs, public libraries, and even homes, the costs can be further minimized. In contrast, traditional analytical methods like spectroscopy (e.g., FTIR or Raman) typically require instruments costing thousands of dollars, extensive training, and considerably longer processing times. Thus, our low-cost centrifuge significantly expands access to microplastics research, enabling broader participation from schools, citizen scientists, and community research initiatives.

1.3 Alignment with Green Chemistry

The protocol follows the principles of green chemistry by emphasizing safety, sustainability, and minimal ecological footprint. Separation relies exclusively on benign, readily available materials such as saturated NaCl solution, household dish soap, and edible vegetable oil, thereby eliminating the need for hazardous solvents or reagents. Consumables are limited, and key items like test tubes can be cleaned and reused; this curbs laboratory waste. Moreover, the centrifuge operates at modest rotational speeds and power draws compared with conventional analytical instruments, which reduces energy consumption. Collectively, these features create a safer working environment and exemplify environmentally responsible experimental design.

1.4 Goals and Future Applications

The centrifuge was developed with three primary objectives: rapid results, affordability, and educational applicability. The quick turnaround time of under 20 minutes per test allows researchers and educators to rapidly iterate experiments and demonstrations. Its affordability ensures that even institutions with limited resources can actively engage in microplastic studies. Moreover, its straightforward design provides an effective educational tool to teach concepts related to environmental science, materials engineering, and sustainability. With developments and fine-tuning, the technique can be further advanced for broader applications, including the detection and isolation of microplastics in biological samples such as blood or urine. The centrifuge machine could evolve into a cost-effective diagnostic instrument, significantly enhancing research into the toxicological and medical impacts of microplastic contamination on human health.

2. Literature Review

Microplastic (MP) contamination has been documented in bottled water, municipal tap supplies, and natural lakes, posing regulatory and analytical challenges across very different water matrices. Frias and Nash (2019) first drew attention to the absence of a universal MP definition, warning that inconsistent size and polymer cut-offs hinder cross-study comparison. Mason et al. (2018) subsequently showed that bottled waters from 11 countries held roughly twice the particle load of paired tap samples, confirming packaging as a non-trivial source. Mintenig et al. (2017) extended the investigation downstream, measuring up to 90 particles per litre in treated wastewater effluent. These baseline data establish the relevance of validating any separation workflow, such as the three-phase brine–oil centrifugation protocol evaluated here, in distilled, tap, and lake water.

Wright and Kelly (2017) synthesized initial toxicological signals linking MPs to oxidative stress and endocrine disruption in mammals. Leslie et al. (2022) later detected polymer particles ($\leq 700\ \mu m$) in 77% of human blood samples, while Panneerselvam et al. (2025) reported placental transfer and adverse pregnancy outcomes. Li et al. (2023) reviewed the underlying mechanisms, DNA damage, and immune dysregulation, concluding that harmonized sampling from everyday drinking sources is urgently required. Tumwesigye et al. (2023) further noted that MPs can act as vectors for persistent organic pollutants and pathogens in freshwater. Collectively, these findings underscore the need for rapid, scalable MP-removal techniques deployable at household taps and lakeside monitoring stations.

Sommerville et al. (2020) explain that density-based separation efficiencies rise sharply once the liquid-phase contrast exceeds $\approx 0.2\ g \cdot cm^{-3}$, favouring saturated NaCl or $CaCl_2$ brines for buoyant polymers. Rani et al. (2023) surveyed more than 80 protocols and reported recoveries above 90% when such brines were paired with mild digestion and spectroscopic confirmation. Mattsson et al. (2022) optimized heavy-liquid extraction for muddy lake sediments, showing that pre-oxidation followed by $ZnCl_2$ ($> 1.5\ g \cdot cm^{-3}$) improves dense-polymer recovery without excessive reagent cost. These insights shaped the present study's NaCl–sample–canola-oil column, applied to tap and lake waters.

Grause et al. (2022) demonstrated that moderate centrifugal forces (≤ 3000 g) and $CaCl_2$ brine separate > 94% of MPs from agricultural soil, indicating that costly ultracentrifuges are unnecessary. The low-cost (≈ 200 USD) rotor used in the current work operates at ~412 rpm and employs an oil pre-coat to extend buoyant capture to polyethylene terephthalate (PET), a modification critical for mixed-polymer tap and lake samples.

Prata (2018) mapped MP pathways through sewers, identifying primary clarification as the dominant removal step. Carnevale Miino et al. (2024) updated these figures, showing that even advanced tertiary barriers discharge up to 6×10^5 particles m^{-3} and recommending retrofit modules based on density separation plus membrane polishing. The brine–oil centrifuge tested here conceptually aligns with retrofit modules combining density separation and polishing and remains viable for small rural plants discharging into lakes because it avoids high-pressure membranes.

Evidence of MPs in bottled, tap, and lake waters (Mason et al.; Mintenig et al.) combined with mounting toxicological concern (Wright and Kelly; Leslie et al.; Panneerselvam et al.; Li et al.; Tumwesigye et al.) makes rapid, economical separation essential. Density-driven protocols (Rani et al.; Mattsson et al.) and centrifugation successes (Grause et al.) converge on the design adopted here. By validating the technique in distilled, tap, and lake water and incorporating lessons from wastewater-plant research (Prata; Carnevale Miino et al.), this study advances a scalable platform for routine MP surveillance across diverse water sources.

3. Materials & Methods

3.1 Materials

Distilled water was obtained from a local convenience store, which stocked an ozonated grade and was therefore adopted for all preparations. Ontario tap water was obtained for the experiment, and lake water was brought from Lake Ontario. For the experiment with soil-water solution, approximately 2 g of soil was prepared for each microplastic sample, and the soil was obtained from Downtown Toronto. Canola oil and food-grade sodium chloride were purchased from a nearby supermarket. The electronic components required for the centrifuge, including an Arduino Uno R4 microcontroller, a direct current motor, a BTS7960 motor driver, and an adjustable power supply, came from Amazon, while auxiliary hardware, such as jumper wires, was purchased from a local electronics shop.

Microplastic test particles were produced by manually cutting everyday consumer items: plastic boxes (polyethylene terephthalate, PET), drinking straws (predominantly polypropylene, PP), and grocery plastic bags (polyethylene, PE). It is important to note that the precise polymer purity and the presence of additives or copolymers were not independently verified and may influence the observed separation behaviour.

3.2 Methods

To quantify recovery efficiency, an individual batch of twenty microplastic fragments of each type with nominal diameters of 100 to 400 μm was suspended in different matrices and transferred to 50 mL centrifuge tubes. Five samples of each plastic were prepared, resulting in a total of 15 samples (i.e., five PP, five PET, five PE) for each matrix (i.e., distilled water, tap water, lake water, soil). The soil-plastic mixture was suspended in 3 mL of distilled water to create a soil-water solution, which was consistently used as the experiment setup. Future studies shall introduce progressively more complex matrices, including saliva, urine, and whole blood.

Initial method development relied on a two-phase oil and water separation. Low recoveries, attributed to particle adhesion to tube walls, suggested replacement of the aqueous phase with saturated brine to create a three-phase brine and oil gradient. This method, using saturated brine, was also further utilized to detect microplastics from tap water, lake water, and soil-water solution.

3.2.1 Method - Water and Oil Separation

Three millilitres of food-grade canola oil were gently layered onto the microplastic suspension. The tube was inverted five times to mix the phases, allowed to stand upright for three minutes, and then centrifuged for 20 minutes at 412 ±

25 rpm. Visual inspection revealed that many particles remained at the bottom of the test tube or adsorbed to the glass wall, resulting in poor overall recovery.

Because visual inspection showed extensive particle loss to the tube wall and pellet, the aqueous phase was replaced with saturated brine to create a three-phase density gradient, as described below.

3.2.2 Method - Brine and Oil Separation

The brine-oil protocol was first validated using distilled water and subsequently repeated, without modification, in tap water, lake water, and a soil-water solution to evaluate performance under more realistic ionic and organic conditions. A fully saturated sodium chloride solution (5 mL; density ≈ 1.20 $g \cdot cm^{-3}$ at 20 °C) was pipetted into the tube, followed by the careful layering of 3 mL of canola oil to establish two immiscible phases. A 3 mL suspension of microplastics in the respective matrices was then added above the brine–oil mixture, producing a distinct three-phase system. The tube was centrifuged at 412 ± 25 rpm for 20 minutes and allowed to rest for 1 minute. Compared to the previous method, this approach yielded markedly higher overall recovery.

4. Results and Discussion

4.1 Results

Table 1 presents the separation achieved with Method 1, the water and oil separation test. The percentages denote the fraction of the twenty starting fragments that were found above the water–oil boundary after centrifugation. Because the particles were large enough to see, we counted them directly through the tube wall. Each value is the mean of three independent trials for that polymer. This method wasn't further analyzed (Figure 1).

Table 1. Recovery (%) from Method 1 - Water and Oil Separation

Plastic Types	**PET**	**PP**	**PE**
Separation Rate	20%	45%	50%

Table 2 lists the arithmetic mean recovery and standard deviation for each polymer achieved with Method 2. Polypropylene (PP) was recovered nearly perfectly in distilled water, indicating 99.0% (SD=2.2%), 98.0% (SD=2.7%) in tap and Lake Ontario water, and 95.0% (SD=5.0%) in soil-water solution. Polyethylene (PE) showed complete recovery in distilled and Lake Ontario water, 99.0% (SD=2.2%) in tap water, and 95.0% (SD=3.5%) in soil-water solution. Polyethylene-terephthalate (PET) separation was 93.0% (SD=5.7%) in distilled water, 90.8% (SD=7.4%) in tap water, 83.0% (SD=5.7%) in Lake Ontario water, and 64.0% (SD=9.6%) in soil-water solution.

Table 2. Mean separation efficiency and associated standard deviation (SD) for each polymer recovered with Method 2 - Brine and Oil Separation in three water matrices (n = 5 tubes per polymer–water combination)

Plastic	**Water type**	**Mean (%)**	**SD (%)**
PET	Distilled	93.0	5.7
PET	Tap	90.8	7.4
PET	Lake Ontario	83.0	5.7
PET	Soil	64.0	9.6
PP	Distilled	99.0	2.2
PP	Tap	98.0	2.7

PP	Lake Ontario	98.0	2.7
PP	Soil	95.0	5.0
PE	Distilled	100.0	0.0
PE	Tap	99.0	2.2
PE	Lake Ontario	100.0	0.0
PE	Soil	95.0	3.5

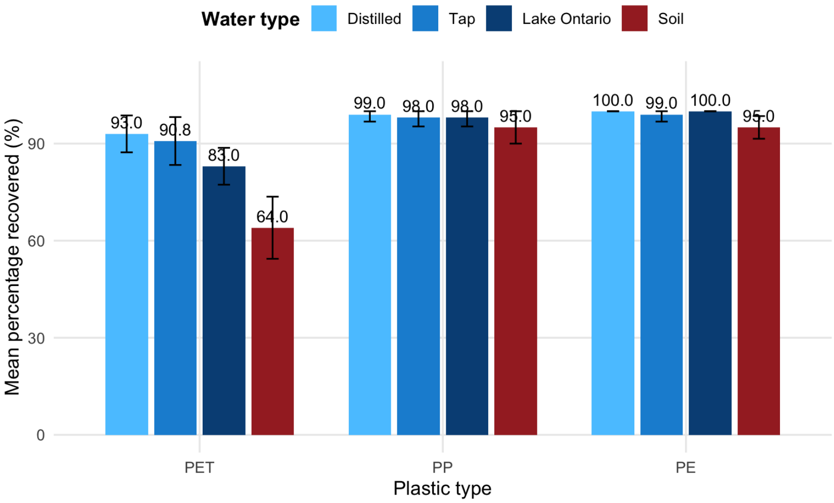

Figure 1. Recovery rate of microplastics by matrix

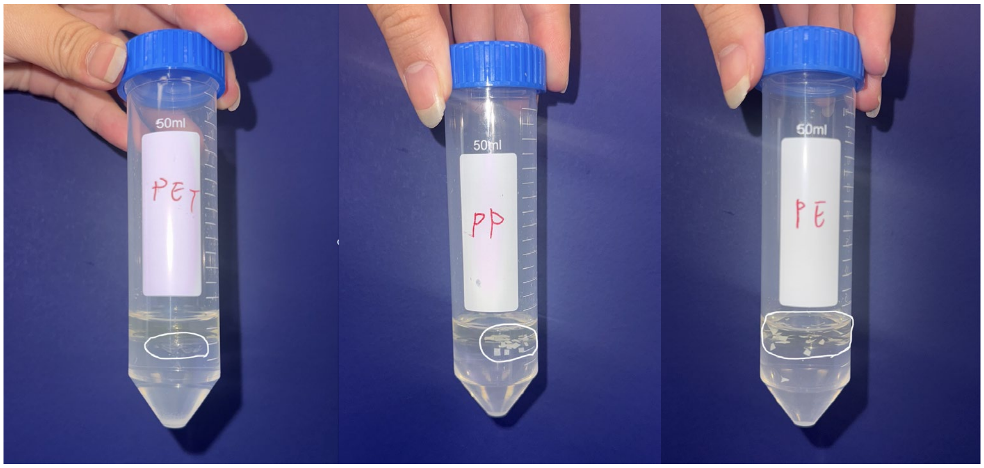

Figure 2. Microplastic fragments recovered from lake water by Method 2: (Left) PET, (Middle) PP, (Right) PE.

Figure 1 provides a visual representation of the data summarized in Table 2. While recovery rates for PP and PE remain consistently high across all matrices, PET shows a marked decline as conditions shift from water-based systems to soil, with recovery reduced by approximately 29% from distilled water to soil. The strong performance of microplastics in water-based matrices is further illustrated in Figure 2, where nearly all microplastics are retained within the oil phase. In contrast, Figure 3 highlights residual settling of PET fragments (left) in the soil–water solution, whereas PP (middle) and PE (right) consistently remain fully captured in the oil layer across all trials.

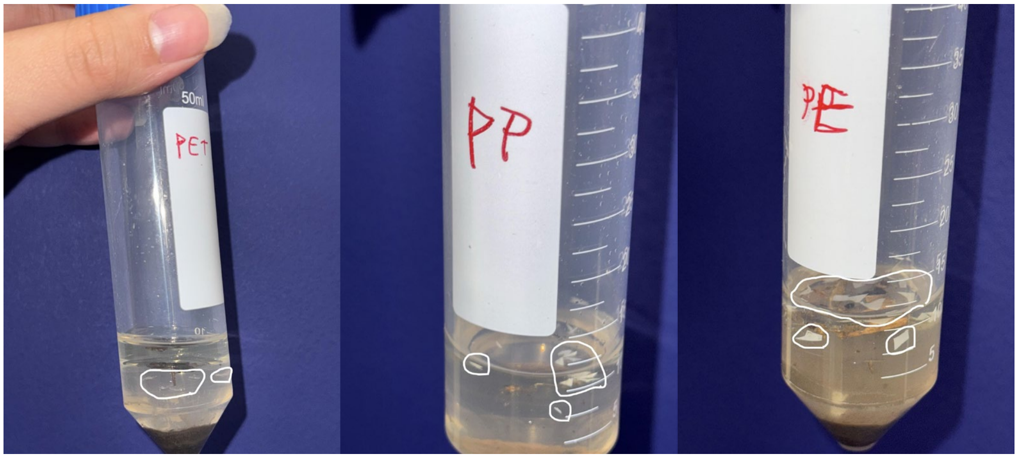

Figure 3. Microplastic fragments recovered from soil by Method 2: (Left) PET, (Middle) PP, (Right) PE.

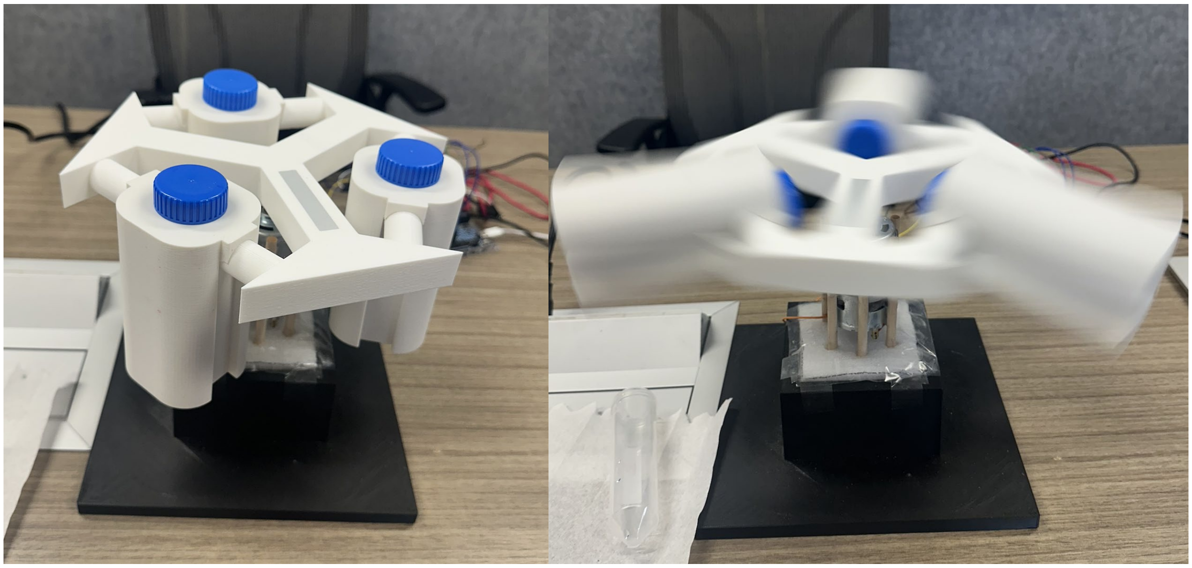

Figure 4. DIY Centrifuge

4.2 Discussion & Validation

For polyethylene terephthalate (PET), recoveries declined from 93.0% (SD=5.7%) in distilled water to 90.8% (SD=7.4%) in tap water, 83.0% (SD=5.7%) in Lake Ontario water, and 64.0% (SD=9.6%) in soil-water solution. Polypropylene (PP) remained comparatively stable, decreasing slightly from 99.0% (SD=2.2%) in distilled water to 98.0% (SD=2.7%) in both tap and Lake Ontario water, and to 95.0% (SD=5.0%) in soil-water solution. Polyethylene (PE) exhibited the highest consistency, maintaining 100.0% (SD=0.0%) recovery in both distilled and Lake Ontario water, with minor reductions in tap water with a recovery rate of 99.0% (SD=2.2%), and soil-water solution with a recovery rate of 95.0% (SD=3.5%). Overall, PET showed the greatest sensitivity to matrix type, whereas PP and PE remained robust. These results underscore the method's decent performance for low-density plastics (PP and PE) and highlight a matrix-dependent reduction in PET recovery that will guide further protocol refinements.

Nevertheless, several methodological constraints limited overall performance and quantification accuracy:

- **Manual phase handling:** Layering and withdrawal with low-cost pipettes induced back-mixing at the brine–oil interface, causing sample loss.
- **Low centrifugal force:** The modest rotor speed (412 ± 25 rpm) generated insufficient g-force to fully displace denser PET fragments with other organic compounds present in the matrix.
- **Operator-biased counting:** Visual enumeration through the glass wall undercounts wall-adhering or sub-visible particles.
- **Lack of physical retrieval:** Microplastics could not be extracted for weighing—separation efficiency was inferred solely via visual interpretation.
- **Undetected sub-visible MPs:** Particles below ~100 µm remained invisible to the naked eye, leading to potential underestimation of total recovery with the current protocol.

To overcome these limitations and further validate Method 2, we propose the following improvements, all adhering to green chemistry and low-cost principles:

- **Precision fluid handling:** Employ calibrated micropipettes or automated syringe pumps to skim microliter-scale volumes cleanly, minimizing back-mixing and reagent waste.
- **Tunable phase densities:** Use a milligram balance to prepare brines from food-grade salts (i.e., $CaCl_2$), enabling fine control of densities above 1.30 $g \cdot cm^{-3}$ to boost PET buoyancy without toxic reagents.
- **Pre-filtration:** Due to the floatation of other organic compounds within the matrix, it is necessary to conduct pre-filtration to remove large debris before the actual experiment.
- **Increased centrifugal force:** Redesign the 3D-printed rotor (lighter infill or tougher PLA blends) with a stronger motor to safely raise speeds toward ~4,000 rpm, sharpening phase separation and reducing spin time.
- **Anti-adhesion treatments:** Apply anti-static or silanized coatings to test tubes to prevent particle sticking and ensure complete transfer to the oil layer.
- **Automated digital image quantification:** After separation, transfer the recovered oil phase into a pre-marked microcentrifuge tube, pipette a defined aliquot onto a calibrated chamber slide, capture high-resolution images with a smartphone-mounted macro lens or USB microscope, and use open-source software (e.g., ImageJ) to count and size microplastics, enabling rapid, filter-free quantification.
- **Fluorescence-based detection for sub-visible MPs:** To capture particles < 100 µm, add a Nile Red staining step after separation. Logging pre-/post-centrifugation fluorescence histograms and overlaying false-colour micrographs adds quantitative and visual evidence without abandoning green-chemistry choices.

Future work will re-evaluate recovery efficiencies under each upgraded condition by repeating five trials in distilled, tap, lake water, soil-water solution, and extending the protocol to biological and high-turbidity samples (e.g., saliva, urine). We will integrate digital image analysis with fluorescence intensity measurements to deliver comprehensive mass-balance confirmation, broadening the method's applicability for both environmental and biomedical microplastic surveillance.

5. Conclusion

This study demonstrates that a 200 USD fully DIY centrifuge (Figure 4), combined with a three-layer brine–sample–oil column, can isolate the three most common consumer plastics rapidly, cleanly, and without toxic reagents. For microplastic particles present in distilled water, the prototype achieved separation efficiencies of approximately 93.0% for PET, 99.0% for PP, and 100.0% for PE. Extending trials to tap water, Lake Ontario, and soil samples, PP and PE recoveries maintained high recovery rates with minor errors, while PET yields were 90.8% in tap water, 83.0% in lake water, and 64.0% in soil-water solution, demonstrating the method's modest resilience in more complex environmental matrices. This performance is attributable to the dense brine cushion, which prevents wall fouling and static adhesion, and to a pre-applied oil film that confers buoyancy even to heavier PET fragments. Because every component is either food-grade NaCl, canola oil, or 3D printed, the apparatus aligns with green chemistry principles and is inexpensive enough for classrooms and community laboratories.

The present work remains a proof of concept: the lack of precision micropipettes, a milligram balance, and microscopic imaging limited our ability to quantify recovery and polymer purity rigorously. The rotor mass held a peak speed near 412 rpm, which is not ideal for a density separation task. Future iterations should add narrow-bore retrieval tools for cleaner fraction collection, integrate low-cost optical or image-analysis modules, test denser or tunable brines for heavier polymers, and lighten or rebalance the rotor to raise relative centrifugal force safely. While the collected dataset now confirms effectiveness in distilled, tap, lake waters, and soil-water solution, further validation in biological fluids such as saliva, urine, and whole blood, and expansion of the particle-count database, will strengthen statistical confidence. With these refinements, the system could evolve into a portable end-to-end workflow for large-scale environmental monitoring and biomedical screening, offering researchers and educators an accessible platform for the global challenge of microplastic contamination.

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Biographies

Nahyun Kim is a student at Urban International High School in Toronto, currently completing Grade 12 with a GPA of 3.97. She has demonstrated strong leadership and academic excellence through a wide range of initiatives in education, research, and community engagement. She is the leader of five school organizations, including the Neuroscience Club, where she writes and publishes papers about neurological diseases, and the Model UN Club, where she serves as Secretary General and leads conferences on global issues such as climate change and cybersecurity. In 2024, she began developing a fundraising website using HTML, CSS, Python, and JavaScript to support endangered animals in Ontario.. Nahyun has previously served as the leader of the Volunteer and Newspaper Clubs, where she organized community outreach efforts and published biweekly newspapers on school and global events. Outside of school, she is a member of the Library Council at the Reference Library in Toronto, where she helps improve library services and writes weekly newsletters.

Seyoon Kim is a diligent and motivated high school student with a strong passion for biomedical and healthcare-related careers. He has maintained a high academic standing throughout his education, having attended Boin High School (GPA: 3.9/4.0), UMC International High School (3.85/4.0), and Urban International High School (4.0/4.0). He is currently conducting a neuroscience research project focused on brain tumor analysis and the rate of tumor growth, aiming to contribute to the medical field through a deeper understanding of neurological conditions. Mr. Kim is actively involved in several extracurricular and academic initiatives. He serves as a leader in the Neuroscience & Psychology Club, and is a member of the Biology Club, Math Elite Club, and Soccer Club, having also competed with the UMC Soccer Team. Demonstrating his dedication to service, he has contributed as a peer tutor in math and science and supported community businesses through advertising assistance for local restaurants. In recognition of his mathematical abilities, he was awarded the Cayley School Medal from the Waterloo Math Contest and was a high performer in the Canadian Senior Mathematics Contest (CSMC). His multilingual proficiency includes Korean, English, Mandarin, Japanese, and French, which enhances his ability to work collaboratively in diverse environments.

Seo Won Yi received an Honours Bachelor of Science with High Distinction in Computer Science (specialist) and Statistics (major) from the University of Toronto in 2024 and earned a Data Science Certificate from the same institution in 2021. Beginning in September 2025, he will return to U of T to complete a Master of Science in Applied Computing (MScAC). Seo Won has worked as a private tutor since 2019, helping high-school students with programming and AP math and physics. In 2024, he joined the university's Astrostatistics group, using Bayesian model-comparison methods for cosmology on cloud platforms. His project work spans medical-image segmentation, an iOS travel-guide app, performing Bayesian statistical analysis, and building machine learning predictive models. Honoured with the University of Toronto Excellence Award, the CANSSI Best Entry Award, multiple Dean's List citations, and several scholarships, Seo Won now aims to build a career in healthcare data science with a focus on personal-care robotics—turning complex data and systems into simple, helpful tools for patients and caregivers.