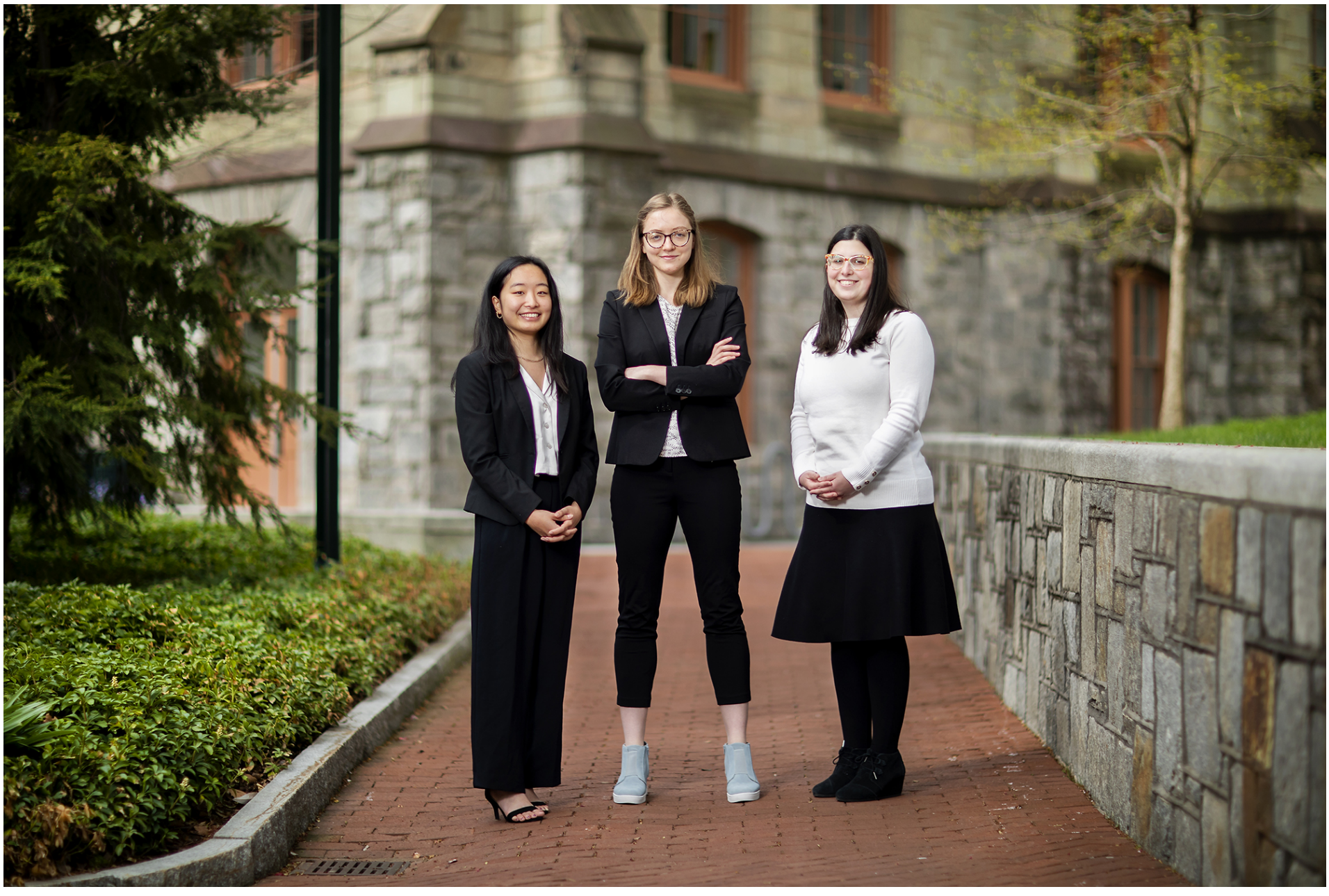
CAMPUS & COMMUNITY

# Engineering a solution for microplastic pollution

May graduates Sarah Beth Gleeson, Shoshana Weintraub, and Julia Yan will use their President's Sustainability Prize to create a device for trapping microfibers in laundry machines to reduce ocean microplastic pollution.



2022 President's Sustainability Prize winners Julia Yan, Sarah Beth Gleeson, and Shoshana Weintraub.

Nearly 14 million tons of plastic (https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution) pollute the world's oceans each year. Along with the significant impacts (https://fortune.com/2015/10/01/ocean-plastic-pollution/) of plastic pollution on marine ecosystems and human health, the negative impacts of smaller particles that are formed when larger pieces of plastic break down in the environment, known as microplastics (https://www.nytimes.com/2022/04/03/science/ocean-plastic-animals.html), are also beginning to be more thoroughly understood (https://www.nature.com/articles/d41586-021-01143-3).

To help reduce microplastic pollution from domestic point sources, a trio of May graduates, all materials science and engineering majors in Penn's School of Engineering and Applied Science (https://www.seas.upenn.edu/), will spend the next year developing Baleena (https://www.baleena.net/), a device for trapping microfibers in laundry machines. As winners of the Class of 2022 President's Sustainability Prize (https://penntoday.upenn.edu/news/class-2022-presidents-engagement-innovation-and-sustainability-prize-winners-announced) (PSP), Sarah Beth Gleeson of Lexington, Kentucky; Shoshana Weintraub of Bala Cynwyd, Pennsylvania; and Julia Yan of Cary, North Carolina will continue working on their senior design project as they create a commercial device for catching microfibers that are released when synthetic clothing is washed.

"Baleena is being thoughtfully designed as an easy-to-use product with a great ability to help improve the environment," says Interim President Wendell Pritchett (https://president.upenn.edu/meet-president). "I am incredibly proud of Sarah Beth, Shoshana, and Julia for their creativity, their attention to detail, and their determination to continue pursuing something so impactful upon graduation."

Gleeson, Weintraub, and Yan formed a senior design team at the start of the academic year and became interested in a project on microfibers (https://www.epa.gov/sites/default/files/2020-07/documents/article_2_microfibers.pdf), small strands of plastic thread that are shed from synthetic clothing during wash cycles, an idea that was pitched by professor Karen Winey (https://directory.seas.upenn.edu/karen-i-winey/).

Throughout the fall, the team met regularly with Winey, full-time lecturer Connor Bilchack (https://mse.seas.upenn.edu/materials-science-and-engineering-welcomes-connor-bilchak-senior-lecturer/), and lab manager Steve Szewczyk (https://mse.seas.upenn.edu/staff/) to discuss specific ideas and trajectories for their project. After looking at possible approaches and learning more about the problem from the Philadelphia Water Department and Penn's Water Center (https://watercenter.sas.upenn.edu/), the team began to focus on creating a device that could collect microfibers at one of their main point sources: washing machines.

"There are filters that attach to your washing machine, but that requires external installation and isn't extremely accessible, especially to people who are renting their homes or don't have in-home laundry access," says Weintraub. "We wanted to make sure that anyone, regardless of their status as a homeowner, could have the ability to filter microfibers out of their laundry."

The team began collaborating with Lexi Voss at Penn Libraries' Biotech Commons to generate and 3D print an initial prototype and iterations of the product throughout the semester.

A CAD rendering and a 3D prototype of Baleena's microfiber-catching laundry ball.

After researching currently available products and designs that individuals could easily use, Baleena's solution is a microfiber-catching laundry ball that can be tossed into any washing machine. Their device, around the size of a tennis ball and with a hard, porous outer shell, holds replaceable filters designed to replicate the high filtration efficiency of natural sea sponges.

PSP award mentor Winey says that Baleena (https://www.baleena.net/)'s focus on tackling microfiber pollution at the point source, as well as their ability to work as a team, has been instrumental to the project's success thus far. "Modern life relies on plastics, so we have to figure out how to manage them and mitigate them with regard to the environment," says Winey. "And as a team, they all have a very strong commitment to the problem, to environmental issues, and sustainability."

Baleena is currently in the research and development phase, and so far the team has developed a prototype device as well as a standardized approach to quantify and characterize the amount of microfibers collected during a typical washing cycle. Now, thanks to the support of their PSP award, which in addition to the funding includes dedicated space at the Pennovation Center (https://www.pennovation.upenn.edu/pennovation-center) and continued mentorship from the Penn Center for Innovation (http://www.pci.upenn.edu/), the three will focus on refining the product, experimental design, leveraging external partners for pilot studies, and expanding their product testing and use conditions.

“At Pennovation, we have a small lab area to continue testing our product,” says Weintraub. “We recently invested in a commercial washing machine that will allow us to test our product in real-world conditions, as up until now we have only tested in lab set-ups. This machine will be set up in our space at Pennovation, which we’re really excited about.”

Gleeson’s role with Baleena during the next year will include product characterization, research and development, and consumer research. One of her main focuses will be on scaling up their testing process as they move to a laboratory setting that allows them to emulate realistic laundry cycles.

Weintraub, whose role in Baleena will be experimental design, prototyping, and polymer synthesis, says that another key focus for the next year is developing a proprietary inner filter and making sure that the fabrication method used by Baleena is both sustainable and scalable.

On the startup-operations and business-development side, which will be led by Yan, Baleena is aiming to leverage existing partnerships with Patagonia, Ocean Wise Labs, and local eco-focused businesses to foster brand recognition and to connect with new partners in the consumer laundry space. Another aspect of Baleena’s business model will be an educational component through an app that allows users to track how many microfibers they collect and see the reductions to their plastic-pollution footprint.

“Another challenge is understanding how to put our best foot forward; this is a big undertaking, so understanding who we reach out to, what resources can be leveraged, and how we fill the gaps in our knowledge” is important, says Yan about the year ahead, adding that she is thankful for the mentorship of Jeffrey Babin (https://eent.seas.upenn.edu/meet-our-faculty/babin/) and Tom Cassel (https://eent.seas.upenn.edu/meet-our-faculty/cassel/) from the Penn Engineering Entrepreneurship Program (https://eent.seas.upenn.edu/) as the Baleena team developed its business plan.

While there is a lot to complete in the year ahead, the team is excited to have another year to work on their senior design project. Their goal is to take Baleena from a concept to a tangible device that can help individuals make a major impact on reducing microfiber pollution.

“I’m excited to keep having the conversations we’ve been able to have and to talk to a lot of different people,” says Gleeson about what she is looking forward to during the coming year. “It’s been really cool to hear all the different perspectives on our project the past year, and I’m really excited to keep having those and to keep thinking about the issue more.”

Winey is excited that Baleena are going to be able to continue this work addressing a challenge with significant, growing interest. “I’m very excited for the product. I want to buy a few dozen and give them to everybody I know because anything we can do to keep microplastics out of the environment is step is the right direction,” says Winey.

*Awarded annually, the President’s Engagement (https://pennpep.upenn.edu/), Innovation (https://pennpip.upenn.edu/), and Sustainability Prizes empower Penn students to design and undertake post-graduation projects that make a positive, lasting difference in the world. Each Prize-winning project will receive $100,000, as well as a $50,000 living stipend per team member.*

*Karen I. Winey (https://directory.seas.upenn.edu/karen-i-winey/) is the Harold Pender Professor in the departments of Chemical and Biomolecular Engineering (https://cbe.seas.upenn.edu/) and Materials Science and Engineering (https://mse.seas.upenn.edu/) in the School of Engineering and Applied Science (https://www.seas.upenn.edu/) at the University of Pennsylvania (https://www.upenn.edu/).*

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SUBTOPICS

**President’s Sustainability Prize, Materials Science, Sustainability, Water, Pennovation Works**

SCHOOLS

## School of Engineering & Applied Science