Please submit this completed application and any relevant supporting documentation to Sustainability-Committee@Illinois.edu. The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the Student Sustainability Committee at sustainability-committee@illinois.edu.

General & Contact Information

Project Name: Single-use plastics reuse and elimination protocols to substantially reduce plastic waste in lab-based science and integrate student campus stewardship into lab training
Total Amount Requested from SSC: $81,865

Project Topic Areas: ☐ Land & Water ☐ Education ☐ Energy
☐ Transportation ☒ Food & Waste

Applicant Name: Jessica Brinkworth
Campus Affiliation (Unit/Department or RSO/Organization): Anthropology
Email Address: jfbrinkw@illinois.edu

Check one:
☒ This project is solely my own ***OR***
☐ This project is proposed on behalf of (name of student org., campus dept., etc.):

Project Team Members

Name	Department	Email
Jessica Brinkworth (lead, faculty)	Anthropology	jfbrinkw@illinois.edu
Nicole Mischak (ug student)	Integrative Biology	Nmisch2@illinois.edu
Rachel Rusen (grad student)	Anthropology	Rrusen2@illinois.edu
Kathrine Van Etten (tech)	Anthropology	Vanettn2@illinois.edu

Student-Led Projects (Mandatory):
Name of Faculty or Staff Project Advisor:
Advisor's Email Address:

Financial Contact *(Must be a full-time University of Illinois staff member)*
Contact Name: Zachary Langheim
Unit/Department: Anthropology
Email Address: zlanghe2@illinois.edu

Project Information

Please review the proposal materials and online content carefully. It is highly recommended you visit a working group meeting sometime during the proposal submission process.

Please provide a brief background of the project, its goals, and the desired outcomes:
You may copy and paste your Step 1 application answer if nothing has changed.

Lab-based science is simultaneously creating and facing an existential crisis stemming from a heavy reliance on single-use lab plastics. Science labs generate ~5.5 million tonnes of single use plastic (SUP) waste annually (Urbina et al. 2015). SUP lab waste expends petroleum resources, fills landfills and oceans, and negates the positive effects of 83% of the world's recycled plastics each year (Urbina et al. 2015). Much of this waste is represented by some of the most reusable and replaceable plastics on the market. Reluctance to refuse or reuse these plastics is rooted in several researcher-held concerns that contribute to a culture of disposability in lab-based science, including contamination by nucleic acids, endotoxin, and oils that may impede experiments, time required to ensure biohazards and contaminants are removed, the urgency of funded research deadlines, and the advent of all in one protocol kits (e.g. DNA isolation). The demands on the modern P.I to produce high impact research in order to attain funding are such that it is simply easier to use and dispose of single use plastics than risk losing research time. As a result, plastics disposability is worked right into modern lab training.

At the moment, lab-based science is also facing major obstruction in research stemming from a reliance on single-use lab plastics. From February 2020 onwards, market demand for certain polymers has exceeded global production capacity (Feng and Cheng 2020). COVID-19 induced production shut downs in the supply chains of plastics commonly used in labs and the effects of climate-change generated catastrophes on highly centralized production site of critical reagents for plastics production have disrupted lab plastic distribution (Herships 2021). In the U.S. the wait time for basic, high demand lab supplies for any lab not protected by the U.S. Defense Production Act for being engaged in COVID testing or vaccine research can be months (Herships 2021). Non-COVID and smaller labs now struggle to complete work in the absence of critical lab plastics. Disruptions are anticipated to continue for years. We propose that the plastics supply chain disruption presents an opportunity to reduce SUP dependency in labs permanently.

The Brinkworth lab is already engaged in developing protocols for the reuse of some SUPs (e.g. pcr plates, plastic petri dishes). The proposed project will help resolve both plastics crises for labs and trainees at UIUC and elsewhere, by developing and promoting affordable, scalable, SUP reuse protocols for a wider range of products (Fig1). We are requesting funds to develop and test three lines of protocols for polypropylene (PP) and polystyrene (PS) reuse and replacement 1) slight modification of a highthroughput PP tip washing and reuse system (modified protocol using TipNovusmini) to include endotoxin removal (ER) for sensitive biology applications 2) a hardware/grocery store product-based system for degreasing, sterilization and ER for PS (e.g. culture dishes) and other PP plastics (e.g. conical tubes) 3) a basic lab equipment protocol for cell work degreasing, sterilization and ER of glass replacing PS plastics (e.g. serological pipets). For the last six months we have been proposing time efficient protocols for SUP reuse or replacement in sensitive applications. This project will test these protocols and develop or modify others covering a wide range of SUPs (Fig 2,3). It will also allow us to demonstrate quality assurance of the resulting reuse systems, via endotoxin testing with a recombinant protein assay (LAL assay). All endotoxins approximate each other in resilience and stability, but not all endotoxin is detectable by this assay. By using positive controls of new plastics contaminated with known amounts of detectable endotoxin subtypes (i.e. lipopolysaccharide carrying an O-ring structure), and assaying water collected from the plastic after cleaning, we will be able to demonstrate the suitability of protocols for sensitive applications (Fig4).

Protocol development, testing, execution and publication will be student-led and student team run. Additionally, a subset of students will be specifically trained in lab plastics refusal and reuse outreach via My Green Lab courses, for purposes of producing communications about this project to other labs. ***Our estimated impact of these polypropylene and polystyrene reuse protocols is a plastics waste reduction of 50-90% per adoptee lab.*** We have engaged the Department of Anthropology, Directorate of Research Safety, and the Institute for Genomic Biology to share these protocols. Our deliverables are 1) tested protocols for SUP reuse (lab website, journal) 2) instructional/promotional videos demonstrating these protocols (e.g. Youtube) 3) recruitment and training of students in protocol development, plastics reuse and plastics reuse outreach 4) recruitment of labs for protocol adoption and use of reused plastics 5) findings memos for IGB to consider adoption of these systems

Where will the project be located? Are special permissions required for this project site?
If special permission is required for this location, please explain and submit any relevant letters of support with the application.

The project will be located in the Brinkworth lab in Evolutionary Immunology and Genomics lab. The is a new, state-of-the-art immunogenomics lab located in the Medical Sciences Building, rooms 550, 553, 558, 559 and 567, approximately 1300 sq feet in size. The space includes a Biohazard Level II tissue culture room approved for human and non-human primate cell culture, a genomic wet lab, and 3 rooms for computational and analytical work. Each room contains the required cell, immunological, microscopy, and genetics equipment required for a fully functioning immunogenomics laboratory. The Brinkworth lab is outfitted with the required major equipment for the proposed project. The tissue culture lab (room 558) maintains a 6 ft BSL2 hood that seats two investigators, microcentrifuges, BSL2 bench-top centrifuge, 19.5L waterbath, combined 4C/-20C storage, 2 CO2 self-decontaminating cell incubators (Heracell VIOS 160i)- one of which can be dedicated to bacterial culture, a benchtop orbital shaker for bacterial culture, 2 vortexers and flammables and acid cabinets, UV spectrometers. The genomics lab is outfitted with a chemical hood and acid drain, 4 microcentrifuges, 1 -20C freezer, 1 4C refrigerator, 1 -80C freezer, 1 PCR thermal cycler (Simpliamp), 4 vortexers, 4 microspin centrifuges, 2 hotplates and 1 stirrer, pH meters, 1 flammable and 1 acid cabinet and ample storage and bench space. The TipNovusmini will be added to this space in room 550. Room 558 and 550 have compressed air at 110 psi and deionized waters supply as required by the TipNovusmini.

The Protocol design and testing will occur in the lab, as will quality assurance (endotoxin testing), using the equipment and spaces described above. Initially most spent plastics will be generated by experiments run via our other immunology and cell culture projects in rm 558. Appliable plastics will be disinfected by soaking in 10% bleach solution for 10 minutes and draining in room 558, before being moved to room 550 for rinsing and cleaning procedures.

Our endotoxin testing approach will include positive controls (e.g. dosing one plastic with a known amount of endotoxin for a known amount of time, and one plastic with known amount of bacteria for a known amount of time). Positive controls will be generated in room 558, before being disinfected via 10% bleach solution and moved to room 550 for processing.

When the protocols are instituted for use, spent, disinfected plastics from other labs in the departments of Anthropology, and then Evolution, Ecology and Behaviour and the IGB will be delivered to room 550, to be processed.

Facilities and Services, Occupational Health and Safety and the Director of Research Safety (DRS) have all provided feedback on this project. No special permissions are required for the pursuit of this project in these rooms other than my own as P.I.. Occupational Health and Safety has offered to check the sound levels and make recommendations on additional personal protective equipment should we incidentally require outside compressed air (a portable air compressor). As per direction from the DRS, as protocols are developed and associated standard operating procedures finalized, they will be added to the Institutional Biosafety Committee protocols for all projects in the Brinkworth lab.

Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that benefit from this project.
Please attach letters of commitment or support at the end of the application.

Department of Anthropology, UIUC
Carl R. Woese, Institute of Genomic Biology, UIUC
Department of Evolution, Ecology and Behavioiur, UIUC

How will this project involve and/or benefit students?
This includes both direct and indirect impact.

The current plastic crisis in not just about disrupted supply chains, and the rippling effects of a devastating pandemic. At its heart, it is the natural outcome of an overdependence on SUP. Modern lab training in biology labs is highly reliant on protocol kits and PP and PS plastics that have replaced the glassware commonly used 40 years ago. In any given lab students are trained, often via marketed kits themselves, that plastic disposability promises results and data consistency, and so SUPs are worked right into the methodological and quality assurance training of future scientists. This project will benefit students by 1) alleviating science trainees of much of this plastic dependence 2) training those students in new marketable skills for science and other fields 3) educating students and PIs outside of the project on protocols they can use to minimize disruptions to their lab programs and their impact on the environment. Student teams will be involved in all stages of the project. This project will benefit students by

1. Developing multiple student teams for specific protocol development, testing reporting by plastic type and instrument, encouraging student collaboration and innovation
2. Training student teams to complete assays important for testing protocols, helping them develop marketable skills for job searches
3. Involving students and having students lead multiple forms of protocol and result reporting, including memo development for UIUC/IGB administrators, Youtube videos and other web content for the public, publication in Human Biology
4. Training students in performance measurement, using SUP waste before and after SUP reuse protocol adoption.
5. Training students in multiple forms of SUP reuse, making ***environmental responsibility*** rather than plastics disposability a reflexive aspect of their training. It will also set up those that intend to pursue lab careers of their own training in cost savings (SUPs are expensive)
6. Retraining students to take responsibility for their research waste
7. Engaging students in conversations with critical UIUC administrators for SUP reuse platform and protocol adoption

8. Training students in environmental outreach and presentation.
9. The SSC funds will contribute to substantially reduced waste in the Brinkworth lab as well as other labs in the College of Liberal Arts and Sciences, and will have spreading effects as Brinkworth lab students graduate and continue their science careers.
10. Providing hourly wages for students over a two year period to design cleaning protocols, train in safe plastics reuse, train incoming students in these procedures, design and complete outreach on plastics reuse for the UIUC community and beyond
11. Training students in a critical immunological assay (LAL Endotoxin detection assay) for quality assurance testing of protocols

How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?

If the grant is awarded, details about the project will be published on the UIUC Department of Anthropology webpage as well as on the Brinkworth lab page. Students engaged in this project will talk to passerby students at SSC Quad day.

We will be reporting our protocols and quality assurance findings to the Associate Director of the Carl R. Woese Institute for Genomic Biology, Dr. Subha Srinivasan who we have engaged to consider the protocols for use in the IGB. Dr. Srinivasan has engaged all research managers of the research themes at the IGB. They have supplied us with questions and we will, in turn, be addressing those questions and reporting our protocols to them.

All final protocols will be posted to the Brinkworth Lab website, as well as published in a short article for the journal Human Biology. Any protocol that is developed will have an accompanying video explanation posted to Youtube. All publications and posts will be advertised on the UIUC Anthropology webpage. Lastly, upon the acceptance of the article to Human Biology, we will coordinate an interview with UIUC LAS News Bureau. We have already engaged with a reporter at the Bureau, who is interested and can submit her resulting piece to science news bureaus will far reach including the American Association for the Advancement of Science EurekaAlert. We will also present on our activities through the Arizona State University Youtube program "Channel Zed", a program where we frequently present our research and outreach efforts.

Financial Information

In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee website. Submission of both documents by the submission deadline is required for consideration of your project.

Have you applied for funding from SSC before? If so, for what project?

In 2019 Brinkworth was the lead for a faculty project entitled: "Joint Pollinator Garden and Composting Systems to Offset Environmental Impact and Reinforce Responsible Stewardship in Research", which expanded the 2018 project and instituted three new garden plots on campus, engaging three departments (Anthropology, Chemistry, Evolution, Ecology and Behaviour). - $32, 157

In 2018 Brinkworth was the faculty Project Advisor for a student-led project entitled: "A Carbon Garden and Compost System to Offset Research Lab Carbon Impact (Davenport Hall Carbon Garden)" won by

undergraduate student Kyle Boshardy. - $6,425

If this project is implemented, will you require any ongoing funding required? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?
Please note that SSC provides funding on a case by case basis annually and should not be considered as an ongoing source of funding.

The project will not require significant ongoing funding from any funder or agency. Within the Brinkworth lab, training on plastics reuse and the protocols will be a matter of course. If a student joins the lab, they will be trained in and use these protocols as part of their standardized lab work. Protocols will be delivered to the IGB for their use and to support their adoption of such systems and published for other researchers to access and use. For the first 12-18 months monies provided by the SSC to Brinkworth will be used to prepare spent lab plastics from the departments of Anthropology and Evolution, Ecology and Behaviour for reuse. When the grant ends, Brinkworth can supply the $300-500 a year required for the cleaning to run the equipment described in this proposal for work within the Brinkworth lab.

To pay for ongoing use and maintenance of the systems for the preparation of plastics for reuse after the grant ends, the Brinkworth lab will set up a revenue account in January 2023. This revenue account will be used to collect a small fee for the cleaning and preparation of plastics for other labs. The precise fee needs to be determined over the course of 2022, to determine the number of hours and reagents required to prepare the plastics and test quality assurance, however it will only cover reagent (i.e. endotoxin assays, detergents), maintenance and hourly worker costs. The net amount in this account annually will be approximately $0.

Please include any other obtained sources of funding. Have you applied for funding elsewhere?
Please attach any relevant letters of support as needed in a separate document.

No other sources of funding have been obtained. There are no outstanding applications for funding at this time.

Environmental, Economic, and Awareness Impacts

How will the project improve environmental sustainability at the Urbana-Champaign campus? If applicable, how does this project fit within any of the Illinois Climate Action Plan (iCAP) goals?

This project will encourage student and employee waste reduction at UIUC through a combination of student training, development of tested SUP reuse protocols, lab to lab engagement on SUP reuse, and SUP reuse outreach. The project is in line with the iCAP major aim of carbon neutrality by contributing to multiple iCAP objectives including multi-level behaviour change, reducing landfill, supporting net-zero waste plan and reusing valuable waste. ***Behaviour change:*** central to this project is the retraining and early training of undergraduate and graduate students to account for their lab-based plastics footprint and empower them to refuse and replace or reuse of SUPs in common and sensitive biology protocols. The entire Brinkworth lab, which is 20+ people in size and growing, will convert to SUP reuse and replacement. Recruitment into the project will be opened to new students as well. For students working in the Brinkworth lab from the launch of the project onwards, SUP refusal, replacement or reuse will be the normal approach to training and completing biological experiments. At the outset of the project multiple student teams will be formed, to develop baseline data on our current waste levels, develop and test individual protocols and systems from SUP point of use to reuse, account for the reduction in waste, complete outreach to other labs and the public, and to run the designed protocols and systems in the Brinkworth lab and others. As part of this project, a core group of students will take the "Waste" training module provided by My Green Lab to learn about the scope of the lab plastics waste issues and alternatives. The same students will take the upcoming My Green Lab "Engagement" course to learn effective outreach techniques to engage with other scientists and promote the use of the protocols and systems. As the systems we will implement are opened up to the rest of the Anthropology Department and later labs in Evolution, Ecology and Behaviour, we will progressively advertise and recruit more researchers to use of these methods by offering initially reuse prep. services for them as each protocol is developed in exchange for feedback on product efficacy. We will report our progress to the IGB, and their research managers, providing protocols, equipment tours and a free reuse service (e.g. box of pipet tips) to interest labs so that they can test the end product. Our protocols will be published in Human Biology in a student-led publication, presented on Youtube in student-produced videos and added to the Brinkworth lab website in student-produced blog posts. This project will produce and support behaviour change at multiple levels of UIUC (e.g. students, faculty, admin) that will spread to other campuses as students graduate, and our protocols are shared. ***Reducing landfill:*** Students of the Brinkworth lab weighed our lab waste by plastic type for several months between 2018 and 2019. Our findings at that time were that we expended ~50 lbs of plastic waste over the busiest 48 hours of our experiment week. Most of this waste is represented by PP and PS plastic, with pipet tips (PP), conical tubes (PP) serological pipets and petri dishes (PS) forming the bulk of that waste. We believe that we reduce our own plastic waste footprint by 50-90% with the implementation of protocols focused on the reuse of PP plastic and reuse or replacement of PS plastic. For our lab alone, the reuse or replacement of any plastic for one use, would see a reduction of 2600 lbs of plastic to 1300 lbs per year. Our experience with pcr plates has indicated that effectively cleaned PP plastics are reusable scores of times, and that glassware replacing PS can be reused indefinitely. Our induction into these protocols alone will lead to a substantial reduction of landfill. As we offer our services for SUP preparation for reuse and share our protocols and services with other labs on campus, this effect will spread. ***Supporting net-zero waste plan***: Any reduction in lab SUP waste will support the iCAP goal of zero waste. By engaging other labs in the Anthropology and Evolution, Ecology and Behaviour departments, and providing reuse services/reused supplies to them we can lower waste coming from other labs as well. However, with the support of IGB administrators and through sharing of protocols and results with such a large center this project can serve as a pilot for substantial SUP waste reduction on campus. ***Reusing valuable waste:*** plastics are a very valuable waste. For example, the low estimated cost of a case of 960 the most commonly used

pipette tips (i.e. 200 ul universal filtered pipette tips) is approximately $200. Each disposable serological pipette costs about $0.5. A typical experiment that runs in my lab every week costs $100 in serological pipettes alone. These SUPs are a valuable resource that can be reused with relative ease or replaced with glassware simply and generate cost savings for UIUC in the process.

How will you monitor and evaluate the project's progress and environmental outcomes? What short-term and long-term environmental impacts do you expect?
Some examples include carbon emissions, water conservation, green behavior, and reduced landfill waste.

SUP use in labs has dramatically risen over the last 40 years, due in part to the discovery of important lab contaminants, development of new protocols, and targeted marketing by plastic manufacturers on the unquantified importance and time savings of "novel" plastics in lab protocols. The result has been a near abandonment of specialized glassware, cleaning of reusable plastics and measured use of SUP. SUP use is pervasive, constant, thoughtless and baked right into student training via kits and marketing. In the short term, via My Green Labs training and student team protocol development, much marketed notions should be dispelled for participating students. Participating students will be asked to produce an anonymous entry slip with their thoughts on SUP reuse, and once protocols are implemented an "progress slip" so that the PI can assess if attitudes are shifting as a result of the project.

In the longer term, we expect a drop in SUP waste in our lab and participating labs. Our lab sorts our SUP waste by plastic type at time of disposal. Over the course of the project and before the implementation of protocols, we will weigh our SUP waste weekly. This will allow us to assess impact of protocol implementation in our own lab, and the efficacy of individual protocols. As labs are brought into the effort, the will be asked to weigh waste for the month before protocol/reusable SUP use and over the months afterwards.

Finalizing, adopting and making public each protocol are also important milestones, as are memo communications with the IGB admin to inform them of our results.

What are your specific outreach goals? How will this project inspire change at UIUC?

We have the specific goals to 1) retrain/train students early in their career in SUP refusal, reuse and replacement 2) introduce other UIUC principal investigators and their labs to SUP reuse and replacement protocols 3) to support adoption of SUP refusal, reuse and replacement by PIs and students outside of UIUC. To reach PIs. **Goal 1** This project will meet its goals and inspire change at UIUC through student recruitment and involvement from the launch of the project. UIUC students, recruited through the Brinkworth lab via previously used mechanisms (Department of Anthropology undergraduate advisor, Department of Anthropology web page, Faculty in the Integrative Biology and Molecular and Cellular Biology departments, Office of Student Engagement). Students will be organized into problem-based themes to develop new or modify existing SUP reuse and replacement protocols to be time efficient and appropriate to sensitive biology applications, test them, publish and publicize them. **Goal 2)** The project team will engage with faculty in the Department of Anthropology, Department of Evolution, Ecology and Behaviour and the Institute of Genomic Biology to introduce them to the developed reuse protocols and systems, and offer free service so that the reused products can be examined and tested by those faculty members. The team will draft memos to IGB admin reporting on results to support their decisions making in adopting such procedures. **Goal 3).** All final protocols will be posted to the Brinkworth Lab website, as well as published in a short article for the journal Human Biology. Any protocol that is developed will have an accompanying video explanation posted to

Youtube. All publications and posts will be advertised on the UIUC Anthropology webpage. Lastly, upon the acceptance of the article to Human Biology, we will coordinate an interview with UIUC LAS News Bureau. We have already engaged with a reporter at the Bureau, who is interested and can submit her resulting piece to science news bureaus will far reach including the American Association for the Advancement of Science EurekaAlert.

If applicable, how does this project impact environmental injustice or social injustice?

Single use plastic waste generated in North America has a devastating impact on the environment outside of the continent. The United States is primary generator of plastic waste worldwide and major contributor to ocean waste specifically, producing 42 million metric one of plastic in 2016 alone (Law et al. 2020). In accounting of legal waste disposal (as opposed to littering and plastic after it is collected for recycling), the United States Environmental Protection Agency estimates that only 9.3% of plastic waste is recycled, while 15.3% in incinerated, and 75.4% ends up in landfill (EPA 2020). SUP waste in the U.S. has an outsized impact on lower and middle income nations. More than half of all U.S. plastics collected for recycling is shipped to lower income nations that cannot adequately recycle the material. Rather, it sits polluting the coast lines of those nations (Law et al. 2020). Another 1 million metric tonnes of plastic are illegally dumped within the borders of the U.S. (Law et al. 2020). Both activities contribute to the formation of oceanic trash vortexes and the introduction of widespread microplastic pollution into marine ecosystems, which most seriously affect peoples living in lower income coastal regions (Ferrol-Schulte et al. 2015; Landrigan et al. 2020). Lower income nations are most substantially impacted by climate change, which degrading plastics in landfills contribute to via the release of greenhouse gas emissions to the tune of 3.8% of the global toll each year (Zheng and Suh 2019). This is nearly double what the aviation industry contributes in global greenhouse gas emissions in a given year (Zheng and Suh 2019). This project aims to empower UIUC students and faculty, and researchers beyond our institution to substantially reduce their contribution to this damage to environment and human health.

References

EPA. 2020. Plastics: Material-Specific Data. In: Agency USEP, editor.

Feng E, and Cheng A. 2020. COVID-19 has caused a shortage of face masks. but their surprisingly hard to make. National Public Radio: Goats and Soda. Boston: WCBU.

Ferrol-Schulte D, Gorris P, Baitoningsih W, Adhuri DS, and Ferse SC. 2015. Coastal livelihood vulnerability to marine resource degradation: A review of the Indonesian national coastal and marine policy framework. Marine Policy 52:163-171.

Herships S. 2021. The U.S. faces another pandemic shortage, this time for lab equipment. National Public Radio, Morning Edition.

Landrigan PJ, Stegeman JJ, Fleming LE, Allemand D, Anderson DM, Backer LC, Brucker-Davis F, Chevalier N, Corra L, Czerucka D, Bottein MD, Demeneix B, Depledge M, Deheyn DD, Dorman CJ, Fenichel P, Fisher S, Gaill F, Galgani F, Gaze WH, Giuliano L, Grandjean P, Hahn ME, Hamdoun A, Hess P, Judson B, Laborde A, McGlade J, Mu J, Mustapha A, Neira M, Noble RT, Pedrotti ML, Reddy C, Rocklov J, Scharler UM, Shanmugam H, Taghian G, van de Water J, Vezzulli L, Weihe P, Zeka A, Raps H, and Rampal P. 2020. Human Health and Ocean Pollution. Ann Glob Health 86(1):151.

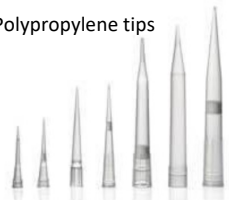
Law KL, Starr N, Siegler TR, Jambeck JR, Mallos NJ, and Leonard GH. 2020. The United States' contribution of plastic waste to land and ocean. Sci Adv 6(44).

Urbina MA, Watts AJ, and Reardon EE. 2015. Environment: Labs should cut plastic waste too. Nature 528(7583):479.
Zheng J, and Suh S. 2019. Strategies to reduce the global carbon footprint of plastics. Nature Climate Change 9:374-378.

Figure 1. Three proposed SUP reuse protocol lines

Lab Plastic types

Polypropylene tips



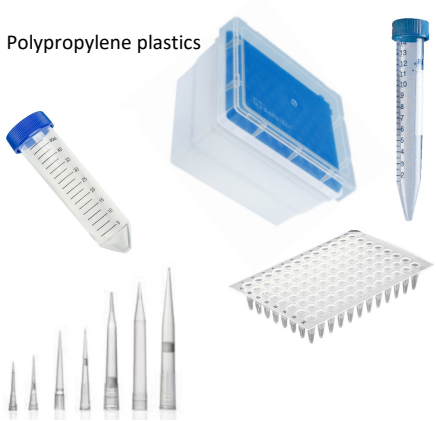
High throughput pipette tip reuse

Disinfection, washing and rinsing → Filter removal and rinsing → Power washing & sterilization

→ Packing and endotoxin removal

Hardware store medium throughput option for PP plastic reuse

Polypropylene plastics



Disinfection and rinsing → Degreasing/ washing → Sodium percarbonate and rinsing → Packing, sterilization and endotoxin removal

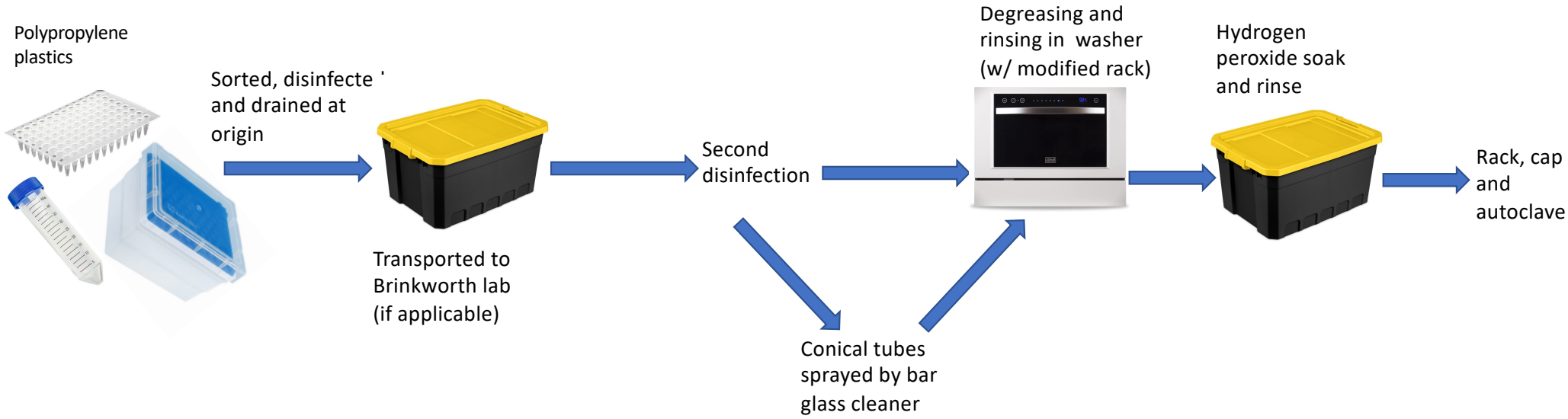
Basic lab equipment medium throughput option for polystyrene reuse and replacement

Polystyrene plastics

Replace w/ glass for indef. reuse → Disinfection & rinsing → Degreasing/ washing → Sodium percarbonate & rinsing → Filter replacement (if applicable), packing, sterilization / endotoxin removal

Reuse → Disinfection & rinsing → Degreasing/washing / rinsing → Chemical endotoxin removal, Ethanol disinfection and UV sterilization

Example hardware store medium throughput option for PP plastic reuse



Example hardware store medium throughput option for PS plastic reuse and replacement

Polystyrene plastics

Sorted, emptied and disinfected and drained at origin

Transported to Brinkworth lab (if applicable)

Second disinfection

Degreasing and rinsing at low temp in washer (w/ modified rack)

Hydrogen peroxide soak and rinse

70% ethanol spray, UV disinfection in BSL2 cabinet

Polystyrene plastics Replaced with glass

disinfected in 10% bleach immediately after use in hood (cosmetics/fridge drawer)

Degreasing and rinsing

Hydrogen peroxide soak and rinse

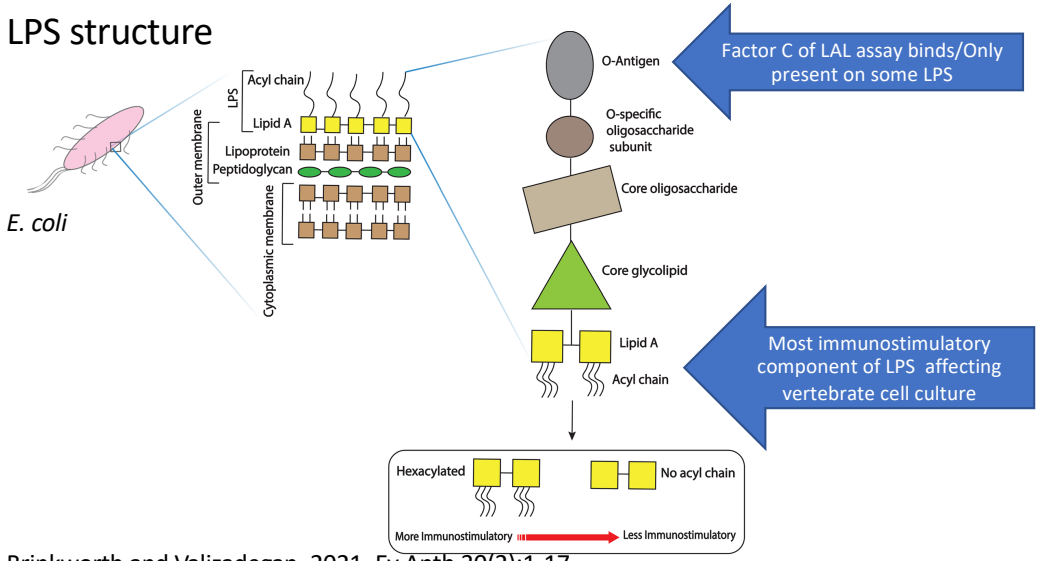
stuff with new cotton (Pipettes only)

autoclave

LAL assay quality control protocol

- **Problem:** Endotoxin/Lipopolysaccharide (LPS) is environmentally pervasive, extremely immunostimulatory and difficult to destroy
- **Solution:** periodically run Endotoxin detection assays (LAL assay using recombinant factor C) to test quality of cleaning procedure
- **Subproblem:** All Endotoxin detection assays rely on binding to the O-ring structure of LPS. Not all LPS has an O-ring, and the O-ring is not the most immunostimulatory component of LPS.
- **Solution:** periodically spike a new plastics with a known amount of LPS with O-ring. Clean with spent plastics and then run Endotoxin detection assay on endotoxin free water collected from spiked and unspiked plastics.

LPS structure



E. coli

Brinkworth and Valizadegan, 2021, Ev Anth 30(2):1-17

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

College of Liberal Arts & Sciences
Department of Anthropology
109 Davenport Hall, MC-148
607 S. Matthews Ave.
Urbana, IL 61801-3636

Student Sustainability Committee
Office of Student Engagement
Illini Union
Suite 284
1401 West Green Street
Urbana, IL 61801

November 17, 2021

Dear Colleagues;

I am very pleased to write a letter in enthusiastic support of Dr. Jessica Brinkworth's exciting sustainability project. The proposal addresses a serious issue in scientific lab research – the frequent disposal of single use plastics. The department of anthropology is in full support of the "plastics reuse " aim of this grant. The goal is to develop protocols to sterilize and reuse lab plastics, which are currently a major source of plastic waste that regularly gets discarded from scientific research labs.

The project will engage and train students in our department in the design and execution of protocols for the reuse of single use plastics, and we fully support the participation in this project of several departmental labs if they wish.

This is an exciting project that moves our department and campus forward towards greater sustainability in scientific research - I recommend it very highly!

Sincerely,

BRENDA M FARNELL (*she/her/hers*)
Professor and Head
Department of Anthropology | Faculty Affiliate American Indian Studies
109 Davenport Hall
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ILLINOIS

Department of Evolution, Ecology, and Behavior
College of Liberal Arts and Sciences
515 Morrill Hall, MC-122
505 South Goodwin Avenue
Urbana, IL 61801

Nov. 18, 2021
University of Illinois
Student Sustainability Committee

Dear SSC Awards committee,

I am writing this letter in support of Dr. Jessica Brinkworth's proposal "Single-use plastics reuse and elimination protocols to substantially reduce plastic waste in lab-based science and integrate student campus stewardship into lab training."

Research labs produce horrendous amounts of plastic waste. Protocols require new/sterile tips, vials, etc… and individual labs go through hundreds of these each day. Any efforts we can make to reduce this waste will be invaluable. This proposal is very forward thinking and has the potential to make a huge impact. I am excited to advertise these new protocols to labs in my own units.

Sincerely,

Andrew Suarez
Professor and Head, Department of Evolution, Ecology, and Behavior
Professor, Department of Entomology

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Carl R. Woese Institute for Genomic Biology

1206 W. Gregory Drive, MC-195
Urbana, IL 61801-3609

Letter of Support

Prof. Jessica Brinkworth
Department of Anthropology
University of Illinois, Urbana-Champaign
109 Davenport Hall
607 S. Mathews Ave.
Urbana IL, 61801

Dear Jessica,

I am pleased to provide this letter in strong support of the your proposal "***Single-use plastics reuse and elimination protocols to substantially reduce plastic waste in lab-based science and integrate student campus stewardship into lab training***" to the student sustainability committee. This is a very exciting proposal that aims to provide a proof-of-concept to resue pipette tips using the tipnovus machine manufactured by Grenova. As a large interdisciplinary research facility, the Carl R. Woese Institute for Genomic Biology, is actively involved in developing team-science approaches to solve grand challenges in science. Your project provides an opportunity for the IGB and campus to limit polystyrene waste from our laboratory research and promote sustainable scientific practices. Additionally, resuable pipette tips also reduce our dependency of plastics and help circumvent supply chain issues which have disrupted research during the pandemic.

IGB laboratory managers are excited to be part of this proof-of-concept project and will provide used (dirty) tips, and test and evaluate cleaned tips from the tipnovus machine. They will share practical opearational feasibility of using cleaned reusable tips for research projects and help identify research areas where it might be difficult to implement reusable methods either due to the sensitivity of experimental conditions or due to scalability.

We are looking forward to hearing regular updates and wish you the very best of luck in this interesting endeavour.

Sincerely,

Gene Robinson