

Grant Proposal for Venture Well- Faculty Grants

Macro Solutions for Microplastics

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Context

This proposal for “*Macro Solutions for Microplastics*” presents a new collaborative STEAM course focused on finding solutions for the national and regional sustainable issue of plastic recycling, microplastic contamination, and non-recyclable plastics. The course combines two disciplines within UTRGV; Chemistry and Fine Arts & Design. It will be supported by a regional environmental organization, Rio Grande International Study Center (RGISC)¹, which focuses on environmental issues with the river and surrounding communities. The specific goals of this course and project are:

- Introduce interdisciplinary student teams to environmental and community concerns along the Rio Grande River
- Apply user-centered design methodologies for innovation in product and service design to create sustainable solutions.
- Guide students’ inquiry using creativity and logic in a STEAM environment to dialogue and apply critical thinking in problem-solving.
- Support a makerspace mindset through project-based learning that combines constructivism and inquiry-based learning.
- Develop innovative solutions in recycling, reusing, and repurposing microplastics.
- Connect entrepreneurial ventures with civic leaders to improve quality of life issues in the Rio Grande Valley.

Collaborators from the environmental organization, RGISC; Dr. Javier Macossay-Torres, a polymer chemist at UTRGV, who will be Co-PI and his current research interests are related to upcycling of plastics. The course will also build on my research from last year as Co-PI on a VentureWell faculty grant. A STEAM class with the business and engineering schools worked in teams to augment engineering projects through our various disciplines.

There are few STEAM collaborations at UTRGV, but we do have the more traditional STEM approaches. This project will fill our STEAM gap and lead to more innovations that support real community needs while producing undergraduate researchers prepared to work in teams and solve challenges from varying perspectives.

Proposed Initiative

Existing and Proposed I & E support

This research proposal builds on existing UTRGV labs and equipment. UTRGV supports a robust sustainability research agenda with numerous grants focusing on greenhouse emissions, oyster larvae harvesting, bee pollination, Alzheimer’s research, sustainable secondary education, and food insecurity. The various schools regularly compete in the iCorp competitions, the Engaged Scholar competitions, Adobe Spark Competitions, and regional design show that showcase undergraduate work. There are existing maker labs and equipment, the Innovation Center that supports entrepreneurial development, and the Latin American Cultural Center promotes regional art and creative works.

This proposal will use the maker lab in the School of Art and the existing chemistry labs, facilities, and tech support as needed. The School of Art houses several 3D printers, maker spaces, and wood, metal, and 3D sculpting materials and equipment. There is a laser cutter, a CNC router, and super high-capacity computers for CAD, 2D, and 3D computers. There are

¹ Rio Grande International Study Center, “About the Rio Grande,” RGISC, Accessed May 10, 2021, <https://rgisc.org>.

student graduate assistants to help, plus admin support in each department. Depending on the solutions required, various capabilities exist to create workable solutions for prototyping. The funding for this proposal provides extrusion equipment to recycle PET plastics for reuse. In addition, supplies for 3D printing and field trips would also be a part of the project.

Potential Project Impact on Sustainability Focused Technology and Innovations

This unique STEAM collaboration focuses on the regional issue of plastic pollution along the bordering river that separated the US from Mexico — The Rio Grande (or the Río Bravo as it is called in Mexico). The World Wildlife Fund calls it one of the top ten most endangered rivers in the world. The Rio Grande is currently facing bacteria, pollution, water mismanagement, invasive plant species, and many other issues.²

Plastics are a ubiquitous problem in our culture and one that produces many hazardous unintended side effects. The Center for Biological Diversity supplies these statistics³: Americans use 100 billion plastic bags a year, which require 12 million barrels of oil to manufacture. The average American family takes home almost 1,500 plastic shopping bags a year. According to Waste Management, only 1 percent of plastic bags are returned for recycling. That means that the average family only recycles 15 bags a year; the rest end up in landfills or litter. It takes 500 (or more) years for a plastic bag to degrade in a landfill. Current research is searching for solutions in creating new sustainable materials, repurposing plastics, recycling plastics, community education, and activism. Innovations in products and community service are emerging globally. The African Plastics Recycling Alliance promotes innovation and collaborates on technical solutions and local pilot initiatives to improve plastics collection and recycling, which creates jobs and commercial activity. The Coca-Cola Company, Diageo, Nestlé, and Unilever launched the Alliance to seek innovative solutions to transform the community.⁴ Some solutions have evolved into turning waste plastic into building planks for homeless shelters during Tsunamis or portable shelter homes for urban nomads made from recycled plastics by companies such as Zo-Loft, or WheelLY among a few companies working on innovation for social good.⁵ Columbian company, Conceptos Plásticos, has constructed real-life Lego houses for the homeless made from recycled plastic bricks.⁶ Innovations like these often combine architects, designers, and makers into the scientific and

² World Wildlife Organization (WWF), “Inspirational leadership on the Rio Grande/Bravo,” Worldwildlife.org., Accessed May 5, 2021, <https://www.worldwildlife.org/stories/inspirational-leadership-on-the-rio-grande-bravo>.

³ The Center for Biological Diversity, “The Problem with Plastic Bags,” Biologicaldiversity.org., The Center for Biological Diversity, Accessed May 5, 2021, https://www.biologicaldiversity.org/programs/population_and_sustainability/sustainability/plastic_bag_facts.html.

⁴ The SDG Knowledge Hub, “Companies Launch African Plastics Recycling Alliance,” Sdg.iisd.org., International Institute for Sustainable Development (IISD), April 2019, Accessed May 6, 2021, <https://sdg.iisd.org/news/companies-launch-african-plastics-recycling-alliance>.

⁵ Meinhold, Bridgette, “WheelLY Provides Sustainable Homeless Shelter,” Inhabitat.com., MH Sub I, LLC dba Internet Brands, May 6, 2009, Accessed May 6, 2021, <https://inhabitat.com/wheelly-sustainable-homeless-shelter>.

⁶ Thakur, Monika, “Lego-like recycled plastic bricks to build houses for homeless,” Homecruz.com., August 12, 2016, Accessed May 7, 2021, <https://www.homecruz.com/lego-like-recycled-plastic-bricks-build-houses-homeless>

environmental sciences mix. We hope to explore similar solutions and products by exploring plastics chemically and creatively for new uses and purposes. This course will create viable product designs and community solutions that support the many challenges of living in a borderland community with low socioeconomic statuses (SES), such as educational attainment, financial security, and subjective perceptions of social status and social class. We will explore ways to support local entrepreneurs, undocumented immigrants and improve the quality of life for borderland colonias⁷, which struggle with many infrastructure issues. Colonias are defined by The Texas Office of the Secretary of State as residential areas along the Texas-Mexico border that may lack basic living necessities like potable water, septic or sewer systems, electricity, paved roads, or safe and sanitary housing.

This project supports innovation through a STEAM collaboration where interdisciplinary teams of students will research the current plastics issues both globally and regionally in the borderland regions and colonias from various perspectives — industrial, chemical, environmental, and product design and manufacturing. The innovative solution applies user-based design principles to design solutions that meet user needs while working with various ways to repurpose or recycle microplastics. The dual approach will lead to new combinations of solutions compared to previous industry and profit-driven directives for manufacturing or mono-focused approaches from either Chemistry or Design alone. The research and innovation are facilitated by building on past research initiatives listed in the next section and Dr. Javier Macossay’s research into polymers and microplastic decomposition. There will be support from the RGISC to build awareness of local impact and activism for regional environmental support. Students will gain the tools to attack this problem from multiple perspectives. Students adapt creativity principles to real-time issues from a macro focus on climate change mitigation by reducing the source of many plastics and their chemical composition to a micro-focus on recycling, repurposing, and reusing existing items for immediate small-scale solutions.

Curriculum and Green Design

This Green STEAM Curriculum will focus on key learning outcomes that blend entrepreneurship with green thinking. Student learning outcomes are:

- Environmental literacy to achieve net neutral outcomes.
- Design thinking and user-centered design applied to regional issues.
- Social responsibility with green product innovation development.
- Plastics lifecycle’s impact on the environment.
- Design, rapid prototyping, and entrepreneurship in product development.
- Research-based interdisciplinary teams.

This curriculum will build on the many VentureWell green resources and Dr. Berger’s experience in User Experience Design, online course development, and STEAM collaborations. Dr. Berger helped develop UTRGV’s new UXUI Master’s Program, STEAM product design, and numerous design courses focusing on visual communication. Dr. Javier Macossay’s research in polymers and microplastics will contribute to the scientific understanding of plastic and its limits. These forms of delivery in a maker culture will create a strong foundational support for the development of this STEAM class.

⁷ Kutz, Jessica, “Who pays for infrastructure in Borderland colonias?”, High Country News, August 5, 2019, May 8, 2021, <https://www.hcn.org/issues/51.13/communities-who-pays-for-infrastructure-in-borderland-colonias>

Dr. Berger recently presented a STEAM framework at the UTRGV Online Innovation Conference — “5-Mindsets of STEAM Education. (See 5-Mindsets, Appendix 4). This framework focuses on the overlapping mindsets from research, target focus, expansive ideation to user testing and implementation. This curriculum has a sustainable design focus emphasizing cradle-to-grave design thinking and exploring sustainable materials used in product design. These guiding parameters are consistent with the VentureWell Inventing Green Toolkit, which guides designers and innovators to build sustainability into their process.

Emphasis is placed on material choices and environmental impact, reducing excess packaging, and extending product life, and specifically to end-of-life for plastics.

Green projects measure sustainability using Life Cycle Assessment (LCA), Cradle to Cradle certification, and EPEAT certification.

The STEAM curriculum is a toolkit that future educators can reuse in blending various disciplines for innovation. There is no directed outcome but a very detailed process that guides students’ thinking to open-ended solutions.

The primary target audience is the Rio Grande Valley regional citizenry. This target market will be a broad demographic with many market segments for age range, socioeconomic status, and educational demographics. The projects that emerge from the team research will address these segmentations, for example, childhood use of plastics, millennial’s use of fast fashion, retail packaging and purchase habits, baby boomers’ habits, and the disadvantaged population that often bear the brunt of the practices of the greater society.

Underrepresented Groups

UTRGV is a member of the Hispanic Association of Colleges and Universities (HACU) and is the third-largest Hispanic serving university in the United States. The student population draws from this monoculture that resides in the border towns of Edinburg, McAllen, Harlingen, Brownsville TX, its surrounding region, and Mexico. The demographic from this area is underrepresented in the STEAM sector, specifically, LatinX, indigenous populations, and women from all backgrounds. This course would enable students to engage with processes that prepare them for the industry.

Key directives that support a broad demographic will be the following:

Market/Recruit: Marketing efforts coordinated with the Latin American Cultural Center at UTRGV and UTRGV’s scholarship programs. Previous program launches started with webinars by the professors, targeted email blasts, and UTRGV marketing efforts.

Mentors: Mentors will be recruited from the professors, graduate students, and regional support from RGISC environmental organization, which has a rich network of volunteers. Through regular group meetings and team meetings students will have opportunities to align with advisors. This group reflects the regional Hispanic demographic and includes women professors and business entrepreneurs from various backgrounds.

Inclusive Content: The curriculum is inclusive in several ways: first, there is no condition for exclusion for this course; secondly, the language is gender-neutral and inclusive. The classroom content is a group process seeking innovation, not the individual source of the ideas. During the course, multi-cultural inspiration in the curriculum highlights Hispanic and minority success stories. This focus is a practice I have used in my design classes to highlight minority designers for students to emulate and show how the design industry is evolving. I find students rarely know of these people that are often left out of art history books. I am adopting a new textbook titled

Black, Brown + Latinx Design Educators: Conversations on Design and Race by Kelly Walters. This book is an excellent source of inspiration and showing the historical path for the design industry. Guest speakers such as Tricia Cortez will speak in their area of expertise and journey. **Assessment:** Various metrics gauge the success of inclusion and diversity from surveys, questionnaires, and observation to established methods from prior research. In the paper by Nelsen Laird (2010), “Measuring the Diversity Inclusivity of College Courses,” a 12-point table seen below measures several ways compiled from prior diversity research that measure a course beyond just the content. The goals, content, perspectives, instructor attitudes, pedagogy, and the classroom environment are all critical aspects of an inclusive curriculum. This course focuses on reaching out to the regional demographic to do user-centered research; this is a natural method for building empathy and inclusivity. The Nelsen Laird study found that active teaching methods influenced diversity inclusion. The making culture in design is an active learning method and another inclusive aspect of the curriculum. The interdisciplinary teams create a natural climate for building empathy and observation amongst students that help gain insights (See Nelsen Laird Table of measuring Diversity Inclusivity Appendix 1).

The Stembridge study highlights six themes in culturally responsive education defined Culturally Responsive Education (CRE) as a mental model — a way to think about the world that more likely ensures that our choices reliably and consciously reflect our preferred mindset. These six themes are good benchmarks to guide pedagogy and help identify themes and tools of practice for closing opportunity gaps.⁸ The main focus that is the goal of all the themes is engagement. Active learning and the maker culture are natural processes that support engagement through making and individual and group interaction. The Stembridge checklist is another reference that will guide the classroom activities (See Culturally Responsive Education CRE, Appendix 2).

Team Process: Student teams will be chosen at random but will include two students from each discipline – two design students and two chemistry students. Teams will have guidelines for weekly meetings based on a contract and division of labor agreed to by all team members. They will turn in progress reports and self-assessments to ensure engagement, accountability, and transparency.

Experiential learning: This curriculum is an active learning format with hands-on research and making. There will be field trips to the river, environmental areas, labs, and guest speakers that present their research. The group dynamic is also an active interaction with group ideation and brainstorming sessions. Over time the team rapport and excitement build as each member sees their input take form. The process of rapid prototyping combined with the creative process of ideation, making, testing, failing, and remaking is a constant practice that builds innovation and a unique team dynamic.

UTRGV Entrepreneurial Support: UTRGV’s School of Business and the Innovation Center help student’s market viable products and ideas and connect to angel investors. Entering various design and STEAM competitions like the UN competitions, Ad League, Indigo awards, and iCorp also provide exposure for student’s work and supports career development. Students learn to combine marketing with visual communication to take ideas to market, as well as self-marketing to raise funds through crowdsourcing programs like Kickstarter in the branding portion of the class. Various media are explored, from print, mobile apps, websites, and social media to advertising to reach their target market for this product. This process is invaluable as a

⁸ Stembridge, Adeyemi. *Culturally Responsive Education in the Classroom* (pp. 61-62). Taylor and Francis.

turnkey process from problem to solution to business start-up. This entrepreneurial support also helps support the region with new business start-ups.

For example, in a prior product design class, one student created a targeted product for a specific need. He applied user-centered design from working with his father, who struggles with Alzheimer's and hand strength, to create a spoon that would not require grip to use and provide independence to the user. This tool design is a simple idea that was not only useful but aesthetically oriented, and we have encouraged him to enter UTRGV's Engaged Scholar Awards 2021. Simple ideas coupled with passion have great potential. These are the types of future-focused projects only a STEAM team can provide with the arts and design experience of branding and communication and the technical aspects offered by the sciences.

Team and Partners:

Dr. Elizabeth Berger is the Principal Investigator for the project and will be instrumental in developing the online course curriculum and introducing students to user-centered design and product design. She is the Chair and Associate Professor for the Graphic Design department at the School of Art and Design and co-coordinator of the newly founded online UX/UI master's program. A designer and design educator of visual communications, her client list range from fortune 500 companies to regional start-ups based in the Dallas-Fort Worth Metroplex. She has produced award-winning work for companies such as American Airlines Publishing, Southwest Airlines, and the American Heart Association to a mom-and-pop chocolate shop in Dubai. Her work appears in national award and design publications such as the New York Art Director's Annual, Print, Graphis Magazine, the Dallas Society of Visual Communications, and the Smithsonian National Graphic Design Archive.

The Co-PI of this project is Dr. Javier Macossay-Torres's, whose research includes polymers in the form of fiber, plastics and microplastic decomposition. He is a Professor in the Chemistry Department at UTRGV. His focus on microplastics is to breakdown plastic bottles made from PET, so the resulting chemicals can be utilized in other chemical processes while benefiting the environment by decreasing the number of PET bottles that will reach rivers, oceans, and landfills. His work is published widely on polymers and their use in the plastic industry.

Professor Timothy Gonchoroff, is a collaborator from the School of Art and program coordinator for the Sculpture area. His previous work centered on weaving with recycled materials and working with sustainable art forms. His input on aesthetic solutions and model making will be a great support for this project.

There will be regional support from RGISC. Tricia Cortez as the director of the RGISC, has sent a letter of support to engage with students and support this class.

Entrepreneurial Ecosystem:

The UTRGV Robert C. Vackar College of Business & Entrepreneurship and the Center for Innovation and Commercialization also hosts a Big Idea Competition annually that would be a good platform for launching ideas. Also, Engaged Scholarship & Learning offers several competitions and scholarships that are also supportive of student research. Adobe Software sponsors the Adobe Jam competition annually, where students solve problems by developing mobile apps. This past year our students placed in two shows with emerging media, a first for UTRGV. The growing design department is reaching out to STEAM collaborations to grow this

area at UTRGV. The design department offers a maker lab, newly launched undergraduate and graduate degrees, curriculum focus with tracks for emerging media.

Work Plan:

The Plan unfolds over a three-year period. Fall 2021 begins the development of the curriculum, gathering resources, and scheduling field trips for the Spring 2022 launch. There will be a comprehensive online curriculum with active learning in maker labs and group meetings. The rapid prototyping process will develop artifacts that are targeted toward solutions and users culminating in creating brand identity for future presentations. Fall 2022-Spring 2023 will refine and build on this course for further offerings into the problem challenge. This could possibly mean the offering of two courses one fundamental and advanced depending on student numbers. After three or more course offerings the data collected in pre and post-surveys, evaluations, interviews, and artifact results, analysis of the effectiveness of the curriculum will be created. The third year will be used to finalize grant reports, enter student competitions, publish journal papers, and attend conferences (See Work Plan Table, Appendix 3).

Outcomes:

The primary academic outcome will be a STEAM curriculum with an innovation and a sustainability focus. This course will help expand the UTRGV STEAM curriculum with further initiatives, developing curriculum, recognition for students, and stronger community relationships. The classroom output will hopefully be viable innovations that support entrepreneurship. However, the most significant goal is to solve a real global threat for a higher quality of life for those along the Rio Grande and future generations.

Measurement methods include acceptance in competitions, investor support, community reaction, and buy-in to the innovation—specific metrics from Pre and Post Tests taken from student surveys and observations on classroom learning.

Student project output and prototypes will be tangible evidence of problem-solving and critical thinking, and innovation. Results will be tied to user research for effectiveness through user testing. The heuristics will help other educators develop STEAM classrooms.

Beyond the grant period, the course will be sustained by expanded to more advanced courses. Other UTRGV Colleges can benefit from this project, and perhaps a STEAM curriculum will emerge that offers students a minor or double major.