

Broadening Participation in Biodesign in the US Southwest

1. Proposal Narrative

Biotechnological developments play an increasingly important role in our lives, whether it is in food, medicines, clothing or building materials. These technologies provide opportunities for scalable greener solutions by using biomimicry as the design method, and cradle to cradle systems for production. The low cost of digital fabrication makes it possible for entrepreneurs to build their own lab equipment and apply biotechnology outside laboratories or institutions. This VentureWell Faculty Grant project, Broadening Participation in Biodesign in the US Southwest, will give students, especially Black, Latinx, Indigenous, women and individuals from low-income backgrounds, at the University of New Mexico (UNM), a Hispanic-Serving and Minority-Serving Institutions, integrated training in biodesign with business idea competitions/business pedagogy/business concepts to prepare them to become entrepreneurs and innovators.

Context: This proposed VentureWell project will strengthen the curriculum in two existing, linked multidisciplinary courses at UNM by integrating business concepts, idea competitions, and mentoring. These courses: Bio Art and Design Lecture and Laboratory, represent a unique collaboration between five departments in the University: Biology, Sustainability Studies, Art, Architecture and Planning and Media Arts. Historically, these classes have drawn underrepresented students, and experiential learning is at the core as students form their own project-based multidisciplinary teams to design, develop and pursue scalable solutions to real world needs through biology-based invention and innovation, aiming towards a positive environmental and social impact. This grant will encourage more students from URG to gain knowledge and experience in biodesign I&E, to learn from I&E experts also from URG.

The **Goals and Objectives** of this project are to:

1. Expand the participation of historically underrepresented students, alumni and faculty, and train them in science and technology innovation and entrepreneurship (I&E) to become part of the next generation of biodesign entrepreneurs.
2. Increase the number of underserved/minority students in biodesign by creating and leading the US Southwest Biodesign Challenge Hub connecting local and regional Title I, HSIs and Native American-serving schools, labs and community organizations.
3. Design and build a state-of-the-art Bio Art and Design learning facility at UNM and link this facility and the US Southwest Biodesign Challenge Hub to entrepreneurial ecosystems at UNM and beyond.

Accomplishments to Date: Supported in part by the Mesa Del Sol Endowed chair held by Dr. Andrea Polli, the Bio Art and Design courses at UNM were developed by Polli initially in conjunction with the BioHack Academy, an international program led by the Waag Society in Amsterdam that brought New Mexico students together with students and community members from around the world, including Tokyo, Seoul, Copenhagen and Melbourne. In an intensive,

boot-camp experience, students across disciplines designed, built, used and shared their own DIY biolab equipment created using open-source design tools, microcircuits, 3d printers and laser cutters. Students learned how to work with this equipment and to conduct experiments towards a specific application or creative project. Through the BioHack Academy, students learned how to grow fuel, food, filaments, fragrances, fungi and much more.

When the BioHack Academy paused after six years of operation, the UNM Bio Art and Design courses were further developed in this boot-camp style through updated learning modules in the aforementioned tools. Team design projects were added as the course became part of the Biodesign Challenge (BDC), an international competition that aims to shape the first generation of biodesigners. Through the BDC, student designers envision, create, and critique transformational applications in biotech with a focus on sustainable development. In the past two years, UNM students received financial support from the BDC to attend the summit in New York City, and students will participate this year for the third time, this time virtually. The winning UNM team in 2019 went on to exhibit their project at the MIT Media Lab.

In 2020, the first BDC Hub was launched to bring together regional practitioners, research institutions, and students to explore and share resources with each other. BDC Hubs are now in Europe, Latin America and the US Midwest, but there is a gap in the US Southwest. As indicated in the Goals and Objectives section, support from VentureWell would fill this gap by supporting a state-of-the-art learning lab and resource hub for biodesign in the US Southwest region.

Proposed Initiative:

The proposed VentureWell project will enhance existing entrepreneurial resources at UNM by supporting a student learning and prototyping facility that integrates digital fabrication and microprocessor electronics with biomaterials and biofabrication, and promotes sustainable design using biomaterials and concepts including biomimicry. Existing campus makerspaces have digital fabrication equipment, but no existing lab on campus combines digital fabrication, electronics and biology. This VentureWell grant would take advantage of lowering prices for bio lab and hybrid bio/digital equipment and supplies to help equip a groundbreaking, state-of-the-art lab in which students move comfortably between digital and wetware project development and prototyping.

Team projects in the Bio Art and Design courses explore the multitude of impacts biotechnology can have on society. Students individually complete modules in 3D modeling and printing, laser cutting and engraving, microcircuits, microbial growth and microscopy. In addition, they choose from hundreds of resources in bio art and design, conduct research, and give presentations to their peers. After gaining this knowledge, each student presents an 'audition' to their fellow students outlining the strengths they would offer a BDC team project, and students generate and discuss their original ideas in self-selected teams of 2-6 students to develop a final project that is juried by a team of UNM faculty across disciplines and local experts for entry into the international BDC. Students are encouraged to create projects that amplify public discussion on desirable and undesirable biotech futures, and engage audiences with projects that challenge cultural norms around human identity, social relationships, and humanity's place in the living

world. These multidisciplinary, multi-level student-created groups imagine ways to address key sustainable biodesign concepts: for example, a healthier and more sustainable food system that benefits the physical, mental, emotional, social, and financial wellbeing of both people and the biodiversity, soil, water, waste, and air quality of the planet. Teams consider how their biodesign could fit into or improve elements within the food system, which includes how to grow, make and sell food, nurture and impact people, and how changing these systems can improve our ability to care for one another and thrive. Students currently work hands-on with Scoby, Mycelium, Slime Mold, fluorescent bacteria and other cultures.

As the climate rapidly changes and drives agriculture indoors, novel measures are required to ensure a secure supply of food and medicine from botanical sources. The proposed lab enhancements would allow students to learn tissue engineering of plants and molecular cuisine techniques. VentureWell funding will allow us to construct custom plant chambers with off-the-shelf components and readymade LED panels with red and blue LEDs as tools for students to use for their biodesign prototypes. Other systems, such as far UV and IR, will allow additional biodesign studies and prototyping. Materials from the VentureWell resources of: Inventing Green Toolkits, Tools for Design & Sustainability, Environmentally Responsible Engineering and Engineering for One Planet will be integrated into the evolving curriculum for the course.

Currently, there is no channel for students who have completed the Bio Art and Design courses and participated in the BDC to further their ideas and prototypes beyond one semester. This VentureWell grant will allow dedicated curricular development towards connecting current and former students with the UNM entrepreneurial ecosystem, including pitch competitions and connections with business partners, supporting the most promising and ambitious teams and technologies towards commercialization. In addition, the creation and development of the US Southwest BDC Hub will further build entrepreneurship opportunities for participants by serving as a center of networking and collaboration between students, alumni, and professionals.

Broadening Participation in Biodesign: The target audience for the Bio Art and Design Lecture and Laboratory courses consists of UNM graduate and undergraduate students in Biology, Sustainability Studies, Art, Architecture and Planning and Media Arts. New Mexico, with 23 Native American tribes where nearly half (49.3%) of the population is Hispanic or Latino, presents a microcosm of the challenges that poor, minority communities in the United States and the world face (US census, 2017). Access to food, potable water, housing, healthcare, electricity and technologies for virtual education and telecommunications challenge many New Mexicans. As of 2019-2020, UNM, the flagship university of the state of New Mexico, has been designated a Minority Institution (MI), with >50% of the total student body (undergraduate and graduate) self-identifying as members of an ethnic minority group (UNM facts and figures 2019, 2020). UNM also has the highest number of Native American students at a highly rated, R1 university.

The integration of art with these courses is important to welcoming URGs and encouraging entrepreneurship in the region. The arts have a strong presence in New Mexico, and their influence extends throughout the state (New Mexico state of the workforce, 2018). Traditional Native American and Hispanic arts anchor Santa Fe as the third largest art market in the country with over

250 art galleries, and many minority communities depend on the arts economy, for example Santa Fe Indian Market or Spanish Market, to provide economic support (Tourism Santa Fe, 2020).

The VentureWell grant will allow us to broaden our reach to students from URGs by supporting six visiting art and design entrepreneurs, themselves from URGs, including Black, Latinx, Indigenous people, women of all backgrounds, and individuals from low-income backgrounds, who will not only interact directly with students in the course, but will give online, recorded public lectures promoted widely across campus, the country, and the world that will serve as a marketing and recruiting tool for future students. These presentations will focus on topics such as: indigenous knowledge and biotechnology, equity in biodesign, and biotechnology and sovereignty, and the presentations will influence and further the inclusivity of the curriculum.

While these visiting experts will serve as mentors during the time of their participation, support from VentureWell will also allow a sustainable network of mentors and mentees to be built through the creation of a US Southwest BDC Hub that will engage former UNM students who have been a part of the BDC, most of whom are from at least one URG, new students taking the course, and students and community members interested in learning about biodesign.

Team

Lead Faculty Member: As a woman faculty member in Art and Computer Science, **Andrea Polli** understands challenges facing URGs and works for equity in STEAM. Since 2014, Polli has directed an AmeriCorps VISTA project STEAM NM (VISTA State #14VSWNM003). STEAM NM has supported hundreds of STEM and STEAM equity projects throughout the state. The project has engaged over 30 VISTAs who have worked with students and community members to fight poverty. Polli will serve as the lead faculty, and will lead the curriculum and hub development for this project.

Lab Faculty Member: Amy Pilling, a woman biology and technology educator who has lived and worked in the Southwest region for over 30 years and served as a STEAM NM VISTA with Polli for two years, will co-lead the curriculum development, deliver the Bio Art and Design laboratory course curriculum and share her extensive network in the region to help identify visiting experts from URGs and build the US Southwest BDC Hub.

Partners: UNM Rainforest Innovations is the center of the university's entrepreneurial ecosystem and will help students move their designs from commercialization to market. In addition, the university has many resources that serve underrepresented and high-need students that will help recruit and serve students, including: El Centro de la Raza (Hispanic Student Services), College Enrichment and Outreach Programs (services for first-generation students), Women's Resource Center, Accessibility Resource Center (disability services), American Indian Student Services, African American Student Services, and The Veteran's Resource Center.

Entrepreneurial Ecosystem: UNM Rainforest Innovations protects and commercializes technologies developed at UNM by filing patents and copyrights and transferring the technologies to the marketplace and connects the business community (companies, entrepreneurs and investors)

to these UNM technologies for licensing opportunities and the creation of start-up companies. Rainforest Innovations's Innovation Academy (iA) is a meta-curricular entrepreneurial program located at the Lobo Rainforest Building in downtown Albuquerque that captures students interested in all aspects of innovation, creativity, and entrepreneurship, and trains them for careers as independent business owners and social innovators. Developed in Fall 2015, the iA has created opportunities open to all UNM students and is committed to serving New Mexico's most underserved populations. Students participating in iA are >50 percent female, >50 percent students of color, and >65 percent first generation college students. The aim of the iA and its programs is to create spaces for these underserved populations to learn and thrive alongside traditional tech transfer professionals and entrepreneurs and to build their enterprise while completing their degree program with world-class support from an R1 research university.

Students who have completed design projects for the BDC who wish to continue on the commercialization path to market will be able to leverage the Rainforest Innovations' and iA's entrepreneurial resources through pitch competitions, mentoring, commercialization resources, startup funding, and other support, as noted in the letter of support from UNM Rainforest Innovations CEO & Chief Economic Development Officer, Elizabeth Kuuttila.

Work Plan:

Summer 2021	Purchase lab equipment and materials, setup and testing
Fall 2021	Formation of US Southwest BDC Hub, curriculum development including VentureWell resources
Spring 2022	Planning first Visiting Expert team from URG Bio Art and Design Lecture and Lab courses with new curriculum integrating entrepreneurship opportunities Visiting Expert 1 and 2 interact with students Appropriate team(s) submit to VentureWell's E-Team program
Summer 2022	2-4 teams of 2-6 students each (expected total 8 students) participate in the BDC Challenge 2022 Equipment maintenance, student BDC projects continue to develop Continued course material development
Fall 2022	Course promotion and US Southwest BDC Hub meeting Planning second Visiting Expert team from URG
Spring 2023	Bio Art and Design Lecture and Lab courses with updated curriculum integrating entrepreneurship opportunities and mentors Visiting Expert 3 and 4 interact with students Appropriate team(s) submit to VentureWell's E-Team program
Summer 2022	3-5 teams of 2-6 students each (expected total 12) participate in the BDC Challenge 2023 Maintenance, projects and course materials continue to develop
Fall 2023	Course promotion and US Southwest BDC Hub meetings and activities

Spring 2024	<p>Planning first Visiting Expert team from URG</p> <p>Bio Art and Design Lecture and Lab courses integrating entrepreneurship and mentors from the US Southwest BDC Hub</p> <p>Visiting Expert 5 and 6 interact with students</p> <p>Appropriate team(s) submit to VentureWell's E-Team program</p>
Summer 2024	<p>4-6 teams of 2-6 (expected total 20) students each participate in the BDC Challenge 2024</p> <p>Maintenance, projects and course materials continue to develop</p>

Outcomes:

We will be successful when we have achieved:

1. A state-of-the-art bio art and design laboratory facility and publicly shared curriculum to guide college students in developing skills, careers and entrepreneurship in biodesign
2. The integration of biodesign into multidisciplinary entrepreneurship options for students, specifically the leveraging of opportunities and resources for students from URGs beyond the one-semester Bio Art and Design courses
3. A functioning, sustainable network of biodesign developers across the state of New Mexico and US Southwest region including alumni mentors from URGs
4. A catalog of resulting tangible biodesign products with real world positive, sustainable impact in the age of climate change

Quantitative metrics will be:

1. Number of students from URG taking the Bio Art and Design courses aligned with or exceeding UNM percentages
2. Number of students and community members from URGs participating in the US Southwest BDC Hub aligned with or exceeding regional percentages
3. Number of Bio Art and Design current and former students from URGs participating in the UNM iA Pitch Competition and other iA/Rainforest Innovations entrepreneurship opportunities aligned with or exceeding UNM percentages
4. Number of entrepreneurial innovations developed and taken to commercialization by current and former students from URGs as reported to the UNM Rainforest Innovations and the US Southwest BDC Hub aligned with or exceeding UNM percentages
5. Number of users and user hours with new biodesign equipment as logged
6. Number of community members and students viewing Bio Art and Design visiting expert presentations (based on previous projects, we expect at least 50 synchronous and 100 asynchronous audience members for each of the 3 public presentations)

Qualitative metrics will be:

1. Biodesign team innovation project documentation (videos, recordings and websites)
2. Bio Art and Design student written evaluations
3. Bio Art and Design and US Southwest BDC Hub student feedback and testimonial