

# **Discovery and Innovation with a Purpose**









**Expenditures** 



Proposals Submitted WPI

# Introduction

#### Greetings

In FY2023, the second year of our current strategic plan, the research enterprise at WPI continues to be committed to enhancing our purpose driven education and research goals. We have expanded current and introduced new ventures to support interdisciplinary discovery and address global challenges from human disease and sustainable development to the future of work, clean energy, and materials of the future.

I am glad to share that WPI has sustained its strong research portfolio, exceeding \$60M in research expenditures. This achievement is evidence of the quality and creativity of our faculty, staff, and students collaborating across a spectrum of disciplines. What's even more significant is the potential societal impact of these projects. They are poised to result in scientific and technological advancements that change the way we live and work, lead to a more sustainable world and promote advancements in health and well-being.

The Office of the Vice Provost for Research is dedicated to supporting our community of researchers, innovators, and entrepreneurs as they expand the impact of WPI locally, nationally, and globally. I would like to take a moment to express my gratitude to the teams that support our research initiatives. Their efforts play a crucial role in enabling the impactful research conducted by our colleagues.

I encourage you to explore our research described below and join us in developing new partnerships.



Bogdan M. Vernescu, Vice Provost for Research



### **Awards**

WPI received \$42.46M in awards in FY23 (Fig. 1). Awards are funds which have been fully obligated and released by the sponsor (Fig. 2). In cases where a grant is funded in yearly increments, only those increments received by WPI are counted as awards.



Fig. 1: Awards Overview



Fig. 2: Awards by Sponsor Type



# SCHOOL

**AWARDS BY** 

## Awards





Engineering



**Business** 



Global





	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Arts & Sciences	\$16,002,966	\$23,401,978	\$19,071,651	\$14,060,218	\$16,291,845
Business	\$659,530	\$672,457	\$1,985,492	\$991,195	\$1,612,831
Engineering	\$18,783,250	\$30,566,966	\$19,555,376	\$30,544,454	\$22,595,040
Global	\$75,175	\$259,245	\$25,232	\$281,479	\$138,681
Others	\$1,331,251	\$1,450,569	\$1,716,266	\$1,835,235	\$1,818,241
Grand Total	\$36,852,172	\$56,351,216	\$42,354,016	\$47,712,580	\$42,456,638

Fig. 4: Awards by School



### **Expenditures**

Expenditures are actual costs for research and educational activities paid from WPI's external and internal funding each year. These costs are recorded in real-time as the research is taking place, unlike awards, which are recorded in total when received. As such, expenditures provide the most consistent year-over-year measure of funded research activity at WPI and partner institutions.

Figures 5 and 6 show the research and education expenditures in FY23. FY19 – FY22 expenditures appear as they have been reported to the NSF through the HERD survey. FY23 expenditures are an estimate.



Fig. 5: Expenditures (in millions) based on HERD survey



Fig. 6: Expenditures for number of students/staff supported on grants

### **Funding Spotlight: Smart World**



Congratulations Markus Nemitz

**Markus Nemitz,** Robotics Engineering, is the recipient of an NSF CAREER Award to develop an innovative architecture for low-cost custom robots capable of traversing challenging terrains by swimming, crawling, climbing, and diving through hostile and confined spaces as part of search-and-rescue operations. His project will focus on developing small and flexible 3D-printed robots with integrated fluidic circuits that can be rapidly fabricated for specific disasters.

**Tian Guo,** Computer Science, has been awarded an NSF CA-REER award to develop novel software techniques that will

improve the performance and privacy of mobile augmented reality (AR) systems, an increasingly popular technology that superimposes computer-generated images on a user's view of the real world. She will focus her project on edge computing, which involves processing data close to its physical source. The proposed techniques, and the resulting software and hardware bundles will be deployed to support indoor AR use cases.



Improving the performance and privacy of mobile AR



Ensuring embedded computing devices are secure and trustworthy

# **Patrick Schaumont,** Electrical and Computer Engineering, has received a grant

from the NSF for a project that will serve as a foundation for future development of tools that automate the detection, diagnosis, and mitigation of hardware fault induced security vulnerabilities in software, with the end goal of ensuring that embedded computing devices are indeed secure and trustworthy. This project will also drive training programs on electrical and optical fault injection instrumentation at WPI.

**Emmanuel Agu** and WPI collaborators **Bengisu Tulu** and **Diane Strong** and researchers from UMass Chan Medical School have been awarded an R01 by the National Institutes of Health to develop a smartphone-based screener that will use photographs, heat images, and algorithms to facilitate early and accurate detection of infected wounds in Point of Care situa-



Developing a smartphone-based screener

tions. The proposed app will also generate evidence-based care recommendations, standardizing the quality of care provided by nonexpert wound caregivers. The goal of the project is to increase the number and

objectivity of wound infections detected outside the wound clinic and fast-track them to the clinic for treatment. Findings will apply to diverse wounds including diabetic, pressure, arterial, venous, surgical and trauma wounds, which all get infected.



# Proposals



Fig. 7: Overview of Proposals Submitted. Number and size of proposals submitted in FY23 do not include Pre-Proposals



Fig. 8: Proposals Submitted by Sponsor Type



# **Proposals**

School	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Arts & Sciences	\$114,604,684	\$107,532,150	\$181,991,609	\$137,055,967	\$89,548,142
Business	\$1,404,014	\$5,050,532	\$4,138,270	\$4,923,625	\$7,314,913
Engineering	\$116,567,646	\$142,986,123	\$131,866,996	\$172,858,221	\$187,755,695
Global	\$372,371	\$918,458	\$1,065,902	\$3,815,712	\$3,920,883
Other	\$2,054,068	\$9,437,850	\$20,123,737	\$7,996,988	\$3,089,321
Grand Total	\$235,002,783	\$265,925,113	\$339,186,514	\$326,650,513	\$291,628,954

Fig. 9: Proposals Submitted by School



Fig. 10: Proposals Submitted by Top Federal Sponsor







Number of Proposals Supported



Amount of Awards Supported



Education & Training Events Hosted

### **Research Solutions Institute (RSI)**

#### **Internal Funding Opportunities: Seed Grants**

The RSI manages Internal Funding opportunities aimed at seeding cross-disciplinary collaborations and supporting preliminary research that will enhance the competitiveness of future proposals to external funders.

In FY23 a new interdisciplinary seed grant program sponsored by the Gapontsev Family Collaborative Venture Fund was launched to support research in photonics, with two more rounds of funding to follow. In this first round, three projects were funded at \$70k each: (i) 2 D nanomaterials for light sensors, (ii) microfluidics for detection of bacteria contamination in packaged food, (iii) biophotonics to detect and deliver drugs to cancers.

The Vice Provost for Research has funded two prototype projects at \$50k each, through the Responsible Innovation Prototype Competition. This program funds seed projects that are pre-company formation and have the potential to be successful in economic AND social impact. This round supports a project to convert bamboo byproducts to clean energy and provide responsible economic development and environmental regeneration to areas affected by deep mining. The second funded project aims to investigate how the built environment affects mental health by developing a multi-modal bio-behavioral data acquisition platform.

#### **Proposal Development**

In FY23 RSI continues to see a rise in demand for its proposal development services. Faculty, students, and staff engaged in research have consistently approached us to help with planning, writing, and reviewing their documents for responsiveness to agency and solicitation review criteria. Our newly offered graphics assistance has also seen a rise in demand. Figure 11 shows the number and value of proposals touched by RSI staff.

#### **Education and Training**

RSI continues to provide training and outreach to WPI researchers. This includes, e.g., grant writing and graphics workshops, faculty panels discussing successful grant-winning strategies, and pre-



Fig. 11: Proposals developed with services from RSI



sentations by federal sponsor representatives. Researchers are appreciating the quality of our programming as attested by the numbers in Figure 12.



Fig. 12: Attendees to RSI Education & Training Events

#### **Manufacturing Innovation Institutes**

WPI has an active portfolio of research and education initiatives in advanced manufacturing through its membership in twelve federally sponsored Manufacturing USA Institutes (MIIs). Synergies among and beyond the MIIs continue to take shape leading to additional funding avenues, cross-team interactions, and expanded impact of MII investment. Spotlight examples include:

**RAPID** Manufacturing USA Institute continues to engage with and fund our graduate and workforce development efforts through contracted courses, certificate programs, internships, and course development funding. They also are developing our technology-to-market strategy for a new Department of Energy (DOE) award that aims to decarbonize wastewater treatment. Several related patents were licensed by River Otter Renewable

**LIFT:** Danielle Cote, Materials Science and Engineering, has received an award from LIFT to support development of novel metal powder created from recycled battlefield scrap metal. This powder will then be re-used as feedstock material for printing new additive manufacturing components, resulting in a more sustainable approach to 3D printing.

**America Makes:** Danielle Cote, Materials Science and Engineering, has received an award from the National Center for Defense Manufacturing and Machining to use atomic-scale computational thermodynamic and kinetic models to more efficiently develop large-scale 3D printed casting replacements. These models significantly reduce the amount of material and time required in traditional development approaches.



Congratulations Danielle Cote



**AIM Photonics:** Douglas Petkie and James Eakin were awarded a 3-year Government Directed Program grant with AIM Photonics, Spark Photonics, Rochester Institute of Technology and Pacific Biosciences to advance photonic integrated circuit silicon nitride development in chemical/biological sensing applications for Naval Research Labs. In addition, they, together with Raisa Trubko, were awarded a multi-year grant through the National Center for Manufacturing Sciences for a positioning, navigation, and timing (PNT) program for Army Research Labs (ARL) with photonic integrated circuits and advancing education and workforce development for ARL pathways.



#### **Research Facilities**

Congratulations Douglas Petkie (left) and James Eakin (right)

**BETC:** The Biomanufacturing Education and Training Center (BETC)

has received funding from the Massachusetts Life Science Center (MLSC) to procure equipment including bioreactors and chromatography systems to provide its students with a more hands-on training experience.

**CERES:** The Cell Engineering Research Equipment Suite, (CERES) created through funding from MLSC, has been supporting faculty research and local startup company research through a strong partnership with Massachusetts Biomedica Initiatives (MBI). Users conduct their research using some of the state-of-the-art equipment including Flow Cytometers, Fluorescence Microscopes, Digital Droplet PCRs, and liquid acoustic handling machines.

**LEAP:** In addition to receipt of the AIM Photonics grants described in the MII section above, LEAP has expanded its company research and fee-for service work: companies using LEAP for prototyping and characterization have included Northrop Grumman Adaptive Optics Associates, Pall Corporation and Pure Lithium. Stanford Research International utilized LEAP equipment with undergraduate student expertise to characterize photonic integrated circuits fabricated at AIM Photonics.

**PracticePoint:** Among the different research groups that use the facility are WPI neuroscientists, who are interested in the simultaneous collection of fNIRS and fMRI neuroimaging data to better understand the applicability of fNIRS in neuroscience research. Another team, which includes Drs. Gregory Fischer, Benjamin Nephew, and Erin Solovey, has built an MRI-conditional hand exoskeleton to collect fMRI data during exoskeleton-assisted rehab exercises. In addition, the facility has seen increased use by its existing and new corporate members. Renewing members include Boston Scientific, Kal Storz, and Aim Medical Robotics; new members include the health start-up Admetsys and Loring Human Factors, Inc., a healthcare and medical devices consultancy firm.



Testing out the MRI-conditional hand exoskeleton



# HIGHLIGHTS OTC





## **Office of Technology Commercialization (OTC)**

The Office of Technology Commercialization (OTC) continues to maintain its target of having 40% of all active cases licensed (Fig. 13). The economic impact from startups and spinoffs is becoming substantial: in 2023, 529 jobs were created, most of them in the region. And capital raised is \$1.679 billion, up from \$220 million last year. Ascend Elements is the leader with \$1.5 billion raised and 350 employees. Others have raised over \$100 million and created over 200 jobs.



Fig. 13: Tech Transfer Activity Trends

The OTC has been creative in using cutting

edge marketing tools to make up for the small staff. OTC has used InPart and FirstIgnite to make connections with potential licensees.





Inventions have been coming from across campus and half of the patent portfolio (Fig. 14) has a student and faculty member as co-inventors, with double the national average of women inventors.

A recent example of a successful faculty/student collaboration is an invention by Prof. Loris Fichera, graduate student Nicholas Pacheco, and senior Ethan Wilke '23. Wilke had the idea for an innovative 3D Pringer nozzle. WPI filed a patent. Mr. Wilke participated in the WPI

I-Corps program and, during his customer discovery, found additional features that he added into his pending patent and found several potential customers. He formed Wilke Design after graduation. WPI licensed in the patent for equity and royalties, and Mr. Wilke is currently negotiating an agree-

ment with a Swedish company he interviewed during his I-Corps experience.

A somewhat unusual example of a student only invention is that of Phase Maze, a game that requires users to guide a ball bearing through mazes of varying difficulty. Maanav lyengar '23, came to WPI with the invention, which he and friends dreamed up when still in high school in Chicago. Mr. lyengar approached the OTC soon after coming to campus as a freshman, and with their help, patents and trademarks were investigated and filed. The OTC also helped Mr. lyengar create a start-up, advised on branding and logo development. The OTC was instrumental in helping Mr. lyengar through the process, and the product successfully made it onto the shelves in June 2022.



Congratulations Maanav lyengar

## **Funding Spotlight: BIOPOINT**



New class of surgical robots

**Loris Fichera**, Robotics Engineering, has been awarded an NSF CAREER grant for a project that will enable a new class of surgical robots to treat disease through the focused delivery of energy, such as light, without cutting or touching human tissues. He will investigate the integration of lasers, radiofrequency, and ultrasonic probes into surgical robots. The project also will apply Fichera's research to experimental devices under development at WPI for vocal chord and brain surgery.

**Jeannine Coburn,** Biomedical Engineering, has been awarded an NSF CAREER grant to develop a transparent wound dressing that was inspired by a natural biopolymer she observed while fermenting kombucha at home. Coburn will determine the chemical composition and crystal structure of a transparent cellulose produced by K. hansenii, the

genes expressed by the bacteria, and how feeding different carbon sources, or sugars, to the bacteria can alter its expression of genes. Additionally, Coburn will develop peptides that interact with the cellulose to deliver peptides that can kill bacteria and disrupt biofilms, which are difficult-to-treat colonies of bacteria embedded within an extracellular matrix.

**Inna Nechipurenko,** Biology and Biotechnology, received awards for two projects that will investigate the genetic basis of primary cilia formation and function in nerve cells. These projects will provide the basic science foundation that is a necessary stepping stone for developing therapies. The first project, funded by the National Institutes of Health (NIH), will determine how a gene called RIC-8 shapes primary cilia structure and function in neurons. The second project, funded by the Charles H. Hood Foundation, will define the function of a human gene called GNAI1 in primary cilia assembly. GNAI1 is a known risk gene for neurodevelopmental disorders.



Genetic basis of primary cilia formation and function

**Elizabeth Stewart,** Chemical Engineering, has been awarded a grant from the NSF Engineering Research Initiation (ERI) program to engineer, validate, and utilize an in vitro biofilm infectionon-a-chip model that effectively replicates a bacteria (Staphylococcus epidermidis) biofilm infec-

tion on a central venous catheter in physiologically relevant conditions at the host-biofilm-device interface. The model developed in this project will be the first of its kind to enable direct visualization of biofilm development at the vascular interface in physiological conditions. Scaling-up the infection model to test antimicrobials will help to reduce the time, cost, and number of animal models associated with antimicrobial development. By utilizing patient-specific bacteria within the device, Dr. Stewart's work could facilitate personalized antimicrobial treatments.

### **Funding Spotlight: MatR**



Symbolic Al architecture

**Lin Cheng,** Mechanical and Materials Engineering, has received a collaborative NSF award for his work that develops symbolic AI architecture to derive materials' constitutive law from experiments that have, heretofore, been very time-consuming and requiring substantial expertise. Cheng is interested in developing scientific AI models to understand the materials behavior and design materials with customized mechano-physical properties.

**Xiaowei Teng,** Chemical Engineering, has received an NSF EAGER award for his work on iron-air batteries, which aims to revitalize iron anode materials by promoting ferrous- and ferric-hydroxides redox and repurpose the iron rust waste into the energy-efficient and low-cost green batteries for modern grid energy storage.

**Danielle Cote**, Mechanical and Materials Engineering, has received two awards (see above under MIIs) for her experimental and modeling work in additive manufacturing.



# CONGRATULATIONS

## to PIs and Co-PIs who received initial awards in FY2023

Departments	Principal Investigator	Sponsor Name	Project Title	Total Award
Aerospace Engineering	John J Blandino	Department of the Air Force	Flexible Fuel Electron Source for Space Propulsion Systems	\$24,905.00
	Nikolaos A Gatsonis	Department of the Air Force	Cathode Modeling for 15 kW Hall Effect Thruster (phase 2)	\$212,641.00
	Raghvendra V Cowlagi	Department of the Air Force	Reconfigurable Manufacturing Systems using Collaborative Robotics	\$499,663.00
Biology & Biotechnology	Andrew Penniman	Massachusetts Life Sciences Center	Strengthening and Expanding BETC Workforce Engagement	\$750,000.00
	Inna Nechipurenko	Hood (Charles H.) Foun- dation	Role of heterotrimeric G proteins in cilia assembly and patho- genesis of neurodevelopmental disorders	\$200,000.00
		National Institutes of Health/NIH/DHHS	Function and regulation of heterotrimeric G proteins in ciliogen- esis and pathobiology of neurodevelopmental disorders	\$363,984.00
	Pamela Weathers	National Institutes of Health/NIH/DHHS	Evaluation of Artemisia as an Effective Combination Therapy Against SARS-CoV-2 Infection	\$68,666.00
Biomedical Engineering	George D Pins	National Institutes of Health/NIH/DHHS	Leaf-Derived Vascular Scaffolds (LeaVS): A multifunctional plat- form for skin regeneration	\$447,877.00
	Jeannine M Coburn	National Science Foun- dation	CAREER: Development of Optically Transparent Bacterial-De- rived Hybrid-Cellulose Biomaterials with Antimicrobial Proper- ties for Wound Treatment	\$606,146.00
		The Kern Family Foun- dation	A New Framework for EML in Undergraduate Research REU Programs	\$118,100.00
	Kristen Billiar	National Institutes of Health/NIH/DHHS	The mechanics of host cell repopulation of engineered tissues	\$429,456.00
	Solomon Mensah	Massachusetts Life Sciences Center	Development of a Grade-12 Project-Based Curriculum for Medi- cal Device Development for Global Health	\$50,000.00
Business School	Andrew C Trapp	National Science Foun- dation	Collaborative Research: FW-HTF-R: Mobilizing Nonprofit Resources and Talents with SHARE: A Community Tool for Pur- pose-Driven Work	\$1,169,914.00
		National Science Foun- dation	RAPID: Data Collection for Designing Refugee Matching Systems	\$72,930.00
		Ascentria Care Alliance, Inc	Assessment of best practices of Neighborhood Support Teams by Data Envelopment Analysis	\$50,000.00
		National Philanthropic Trust	Empowering displaced persons and communities through job placement and social inclusion with innovative technology in Mexico and Colombia	\$109,294.00
	Bengisu Tulu	National Institutes of Health/NIH/DHHS	Development of a Text Intervention for Perinatal Depression	\$71,924.00
Chemical Engineering	Andrew R Teixeira	Department of Energy	Removing Physical and Chemical Bottlenecks for Hydrothermal Waste-to-Energy through Intensified Conditioning of Blended High Solid Waste Slurries	\$1,178,551.00
		Sinclair Energy Partners Ltd	Direct Ammonia SOFC Demonstration	\$25,000.00
	Elizabeth J Stewart	National Science Foun- dation	ERI: Engineering a biofilm infection-on-a-chip to elucidate the host-biofilm interface	\$200,000.00
	Michael T Timko	Braskem	Supercritical Water Compatibilization of Polyethylene and Polypropylene	\$12,234.00
	N A Deskins	National Science Foun- dation	Kokes Awards for the 28th North American Catalysis Society Meeting	\$50,000.00



Departments	Principal Investigator	Sponsor Name	Project Title	Total Award
Chemical Engineering	Xiaowei Teng	National Science Foun- dation	Collaborative Research: Understanding the Materials Chemistry to Engage Anion Uptake and Release in Layered Transition Metal Oxides and Hydroxides	\$357,455.00
		National Science Foun- dation	EAGER: CAS-Climate: Revitalizing Iron Hydroxide Electrode for Energy-Efficient Green Batteries by Promoting Ferrous- and Ferric- Hydroxides Redox	\$201,681.00
Chemistry & Biochemistry	Patricia Musacchio	National Institutes of Health/NIH/DHHS	Mild Strategies in the Direct Generation of Carbocation Interme- diates from C(sp3)–H Bonds	\$1,806,648.00
		Pfizer Inc., U.S. Pharma-	Musacchio Experiential PhD in Chemistry (Pfizer)	\$5,000.00
		ceuticals Group	Enabling Late-Stage Cyanations, Amination & Sulfonaminations of Aliphatic Csp3–H Bonds	\$125,000.00
	Ronald Grimm	Department of the Army	Effective protection of Warfighters from chemical warfare agents	\$1,669,998.00
Computer Science	Craig A Shue	Department of Defense	2022 DOD CySP Worcester Polytechnic Institute - Cyber Scholar- ship Program 2022-2023	\$98,432.00
	Elke A Rundensteiner	Department of Agri- culture	Innovative Big Data Analytics Technology For Microbiological Risk Mitigation Assuring Fresh Produce Safety	\$82,162.00
	Emmanuel O Agu	National Institutes of Health/NIH/DHHS	Smartphone-based wound infection screener and care recom- mender by combining thermal images and photographs using deep learning methods	\$2,458,174.00
	George T Heineman	Department of Defense	MIT/LL MQP Project Center	\$19,180.00
	Jacob R Whitehill	The Eric and Wendy Schmidt Fund for Strate- gic Innovation	"Hybrid Human-Agent Tutoring (HAT) Platform to Accelerate Middle School Math Achievement for Low Income Students"	\$573,553.00
	Neil Heffernan	Department of Edu- cation	Recovering from COVID-Learning-Loss with a Platform to Support Human Tutoring	\$1,000,000.00
		Jaffe Foundation	Leveraging Artificial Intelligence to Analyze Students' Math Work Uploaded in a Digital Platform	\$120,000.00
		National Science Foun- dation	Using ASSISTments for College Math: An Evaluation of the Effec- tiveness of Supports and Transferability of Findings	\$90,000.00
		The Eric and Wendy Schmidt Fund for Strate- gic Innovation	Cyberinfrastructure for Learning Engineering Research & Devel- opment	\$150,000.00
	Rose Bohrer	National Science Foun- dation	Homotopical Logic Programs	\$164,646.00
	Tian Guo	National Science Foun- dation	CAREER: Toward a Specialized Edge for Augmented Reality	\$657,776.00
Electrical & Computer	Bo Tang	National Science Foun- dation	CAREER: Towards Biologically Inspired Lifelong Learning with Multimodal Association	\$250,000.00
Engineering	Edward A Clancy	Department of Defense	Wireless Non-Invasive Advanced Control of Microprocessor Prostheses and Orthoses II	\$350,000.00
	Patrick Schaumont	National Science Foun- dation	Collaborative: FMitF: Track I: A Principled Approach to Modeling and Analysis of Hardware Fault Attacks on Embedded Software	\$435,051.00
	Sergey N Makaroff	National Institutes of Health/NIH/DHHS	CRCNS: Multifocal causal mapping of brain networks supporting human cognition	\$215,137.00
	Shahin Tajik	Electric Power Research Institute	Hardware Based Reference Signatures Phase 2	\$171,629.00
	Ulkuhan Guler	Department of the Army	Transcutaneous Oxygen Monitor (TOM)	\$56,164.00
Fire Protection Engineering	Albert Simeoni	Lockheed Martin Cor- poration	Quantifying the dependency between fuel inputs and fire prediction accuracy	\$150,000.00
		California Department of Forestry and Fire Protection	Development of Engineering Tools for Exposure Analysis at the Wui	\$514,981.00
		National Science Foun- dation	Planning: FIRE-PLAN: Planning Megafire Research Across Scales and Disciplines	\$18,792.00

### Funding Spotlight: GLOBAL INITIATIVES and LOCAL COMMUNITIES



WPI Puerto Rico Project Center

**Mimi Sheller** and her team from the Global School have been awarded funding to co-create a Caribbean Climate Adaptation Network, a NOAA Climate Adaptation Partnership CAP/RISA Team. The University of Puerto Rico is the lead institution, with collaborators from nine academic institutions and agencies across the continental United States, Puerto Rico, and the US Territories of the Virgin Islands (USVI). The goal of collaboration is to foster knowledge sharing for more sustainable and equitable strategies for climate-action and community empowerment throughout Puerto Rico and the USVI. This network is designed to help build adaptive capacities for future climate extremes, with specific attention to climate hazards related to extreme rainfall, extreme heat, drought, landslides, and coastal and riverine flooding. WPI students, both graduate and undergraduate, are also participating in the research through the WPI Puerto Rico Project Center and the interdisciplinary graduate program in Community Climate Adaptation.

**Solomon Mensah,** Biomedical Engineering, has been awarded a grant from the Massachusetts Life Sciences Center to develop a seven-week summer program for high school students who are interested in developing medical devices for global health. The program is aimed at under-represented students in the Worcester Public Schools and focuses on the ideation, design, and implementation of medical devices for developing countries.



Worcester Public School students



Empowering displaced persons and communities in Mexico and Colombia

Andrew Trapp, Business School, has been awarded a grant from the Na-

tional Philanthropic Trust for a project that aims to empower displaced persons and communities in Mexico and Colombia. This project proposes to scale and enhance a proven job and social inclusion model together with a recently developed, effective, and innovative platform for fair matching of diverse talent including migrants to stable employment. This solution is creating greater opportunities for vulnerable persons in a practical way, advancing diversity, equity, and inclusion practices in recruitment, and positively impacting the economy and society.



Departments	Principal Investigator	Sponsor Name	Project Title	Total Award
Fire Protection Engineering	James Urban	Federal Emergency Management Agency	Fighting fire toxicity: improving safety and health via novel optical sensors	\$304,247.00
Graduate Studies	Rory J Flinn	National Science Foun- dation	ASPIRE Central Massachusetts Regional Collaborative for inclu- sive and diverse STEM faculty	\$81,249.00
Humanities & Arts	Jennifer deWinter	Department of Edu- cation	Integrating Japan Area Studies into the WPI STEM Curricula	\$197,078.00
Innovation & Entrepreneurship	Mitra V Anand	VentureWell	Innovation Through Making Course: Creating a Distinctive Proto- typing Experience as part of a New Entrepreneurial Pathway	\$28,740.00
Mathematical Sciences	Francesca Bernardi	National Science Foun- dation	Collaborative Research: Pretreatment, aging, geometry, and regeneration effects on spatiotemporal ultrafiltration fouling: An experimental and theoretical investigation	\$109,767.00
	Francesca Bernardi	Simons Foundation	Investigating diffusion and transport at the microscale	\$42,000.00
		Mathematical Associa- tion of America	Girls Talk Math at WPI: Improving Students' attitude towards challenges and self-confidence through a math and media camp	\$6,000.00
	Gu Wang	National Science Foun- dation	Optimal Contracts and Optimal Stopping	\$260,000.00
	Randy C Paffenroth	Defense Advanced Re- search Projects Agency	Messina: Enabling Confidence	\$29,697.00
	Samuel Walcott	National Science Foun- dation	IntBIO: Linking genome to phenome to understand function of an ancient muscle myosin in complex heterogenous systems	\$276,208.00
	Thelge B Peiris	National Science Foun- dation	REU Site: Research Experiences for Undergraduates in Industrial Mathematics and Statistics	\$412,937.00
	Vladimir Druskin	Air Force Office of Scien- tific Research	Reduced Order Model Algorithms for SAR Imaging in Multi-Scat- tering Dispersive Environment	\$298,563.00
Mechanical and Materials Engineering	Adam Powell	Massachusetts CEC	Magnesium-Air Battery for Zero-Emissions Shipping, Rail, and Aviation	\$65,000.00
	Ahmet C Sabuncu	MassVentures	TwitchCLIP: A Quantitative Train-of- Four monitoring device for monitoring neuromuscular blockade in patients undergoing surgery	\$16,250.00
		The Kern Family Foun- dation	Archival Publication Authors Workshop for Engineering Faculty	\$5,000.00
	Aswin Gnanaskandan	National Science Foun- dation	ERI: Elucidating the Mechanism and Effects of Enhanced Thermal Ablation of Tissues by Microbubble Assisted High Intensity Focused Ultrasound	\$199,266.00
	Brajendra Mishra	Automotive Recyclers Association	Quantifying the greenhouse gas emissions (carbon) impact of reusing automotive parts for vehicle repairs	\$56,406.00
	Cosme Furlong-Vazquez	Department of Energy	In-Situ Inspection of AM of Energetics: Digital Fringe Projection (DFP)	\$937,013.00
	Danielle L Cote	ASM International	CMPD: Temperature Dependent Material Flow and Materials Data Analysis	\$10,263.00
		Office of Naval Research	Cold Spray Research and Development - Phase II	\$408,500.00
		Department of Defense	Computationally Driven Reliability & Repeatability for Wire Arc Additive Manufacturing of High Strength Maraging 250 Steel (Phase I STTR)	\$17,298.88
		Department of the Air Force	SWAAHT - PHASE I	\$1,050,000.00
	Lin Cheng	National Science Foun- dation	Machine learning powered simulation of additive manufactur- ing for real-time design and process optimization	\$10,150.00
		National Science Foun- dation	CDS&E/Collaborative Research: A Symbolic Artificial Intelligence Framework for Discovering Physically Interpretable Constitutive Laws of Soft Functional Composites	\$287,689.00



Departments	Principal Investigator	Sponsor Name	Project Title	Total Award
Mechanical and Materials	Masood Ghasemi	Department of the Army	Responsible AI-Based Control of Unmanned Ground Vehicles in Severe Dynamic Terrain Environments	\$249,946.00
Engineering	Mehdi Mortazavi	Massachusetts CEC	Acoustic Pressure Wave Superimposed (APWS) PEM Fuel Cells: In-Situ Characterization and Testing	\$49,114.56
	Pratap M Rao	Department of the Army	CLIN 2601 - MN31 - Hydrogen Production from Solids via Atmo- spheric Pressure Low-Temperature Plasma	\$116,217.00
	Robert Hyers	AM Batteries LLC	Electrode Testing and Characterization	\$29,957.00
	Yan Wang	Plug Power Inc.	Recycling of Precious Metals and Perfluorinated Materials from Fuel Cell and Electrolyzer Membrane Electrode Assemblies	\$240,000.00
		Department of Energy	Impurity Study of Recovered NMC622 Precursor and Cathode Materials (3F-60137)	\$60,000.00
	Yihao Zheng	National Institutes of Health/NIH/DHHS	Smart Aspiration Catheter Based on Fiber Optic Pressure Sensing for Mechanical Thrombectomy in Stroke	\$460,088.00
		Guangzhou Boxin Medi- cal Technology, Ltd	Experimental Investigation of A Next Generation Atherectomy Device	\$50,000.00
		Renal Research Institute, LLC (RRI)	RRI: point of care 3D sonogram	\$15,456.00
	Zhu Mao	Air Force Office of Scien- tific Research	Multi-Layer Surrogate Modeling via Bayesian Approach and Non-Contact Full-Field Measurements	\$67,743.00
Physics	Douglas T Petkie	AIM Photonics - The American Institute for Manufacturing Integrat- ed Photonics	Wideband Ultralow Loss and Fluorescence Nitride-Optimized Sensors Platform	\$299,970.00
		Department of the Navy	Integrated Photonics for Sustained Operations	\$450,000.00
	Germano S lannacchione	National Science Foun- dation	NSF IPA agreement for 2023	\$213,424.00
	William McCarthy	Nuclear Regulatory Commission	WPI Nuclear Science and Engineering Undergraduate Scholar- ship Program - 2023	\$199,540.00
Robotics Engineering	Berk Calli	National Science Foun- dation	POSE: Phase I: Collaborative Open-Source Manipulation and Perception Assets for Robotics Ecosystem (COMPARE)	\$38,753.00
	Cagdas D Onal	National Science Foun- dation	CIVIC-PG Track A: Rapidly Deployable Robotic Inspection and Mapping of Complex Spaces	\$49,999.00
	Carlo Pinciroli	National Aeronautics & Space Administration	ASTER Phase II	\$305,877.00
	Haichong Zhang	National Institutes of Health/NIH/DHHS	Automatic Wide-Field Optical Coherence Tomography for Assessment of Transplant Kidney Viability	\$493,446.00
	Loris Fichera	National Science Foun- dation	CAREER: Next-Generation Surgical Robots for Energy-based Surgery	\$599,663.00
	Markus Nemitz	Department of the Army	UAV Liquid Hydrogen Autonomous Refueling System	\$907,480.00
		National Science Foun- dation	CAREER: Additively Manufactured Soft Robots with Integrated Fluidic Logic and Flexible Electronic Interfaces	\$599,815.00
Social Science & Policy Studies	Erin R Ottmar	National Science Foun- dation	From Sight to Insights: Examining Effects of Perceptual Cues on Students' Mathematical Reasoning and Learning	\$667,617.00
	Gbetonmasse B Somasse	The Kern Family Foun- dation	Archival Publication Authors Workshop for Engineering Faculty	\$5,000.00
	Ji-Eun Lee	Walton Family Founda- tion, Inc	Math Achievement and High School Course-Taking Trajectories Before and After the COVID-19 Pandemic	\$49,864.00

Departments	Principal Investigator	Sponsor Name	Project Title	Total Award
STEM Education Center	Katherine C Chen	National Science Foun- dation	Implementation and Evaluation of the ARIS Broader Impacts Toolkit	\$25,000.00
		Massachusetts Depart- ment of Elementary and Secondary Education	Central MA STEM Network Year 8 \$35k Grant	\$35,000.00
	Mia Dubosarsky	Massachusetts Depart- ment of Elementary and Secondary Education	Accelerating Science: Open Access Professional Learning	\$54,250.00
The Global School (previously IGSD)	Krista Miller	Institute of International Education	IIE American Passport Project	\$4,125.00
	Mimi Sheller	National Oceanic & Atmospheric Adminis- tration/Department of Commerce	Caribbean Climate Adaptation Network: Building equitable adaptive capacities of the US Virgin Islands and Puerto Rico.	\$674,254.00

A special thank you to the individuals who — through their hardwork — have contributed to the successes reported in this annual report.

Office of Vice Provost for Research (OVPR)

Antje Harnisch

Office of Sponsored Programs (OSP) Orla Baxter, Michelle Mulkern, Kristen Bronger, Nicole Caligiuri, Courtney White, Chelsea Holland, Kristin Keane, Klelia Loloci-Silvestri, Katelyn Turnbull

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Gabriel Johnson

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Todd Keiller, Sarah Mahan, Lynda Kelly

**Research Solutions Institute (RSI)** 

Sujatha Koduvayur, Ben Nephew, Ellen Piccioli, James Eakin, Priscilla Vazquez Sponsored Programs Accounting (SPA)

Heather Bilotta, Amanda Hickson, Colleen McShea, David Musto, Jennifer Wood

This report, published annually by the Office of the Vice Provost for Research, aims to provide a summary of key data related to WPI's extramural funding activities, including proposals submitted, awards received, and funds expended. As with prior years, this report includes only those proposals and awards administered by OSP. Gifts, internal funding, individual fellowships, and MQP/IQP project funding are not included here. We welcome your feedback on this report. Comments and suggestions can be submitted via email to Priscilla Vazquez, Research Development Manager (pvazquez@wpi.edu).

Report layout, design, and Tableau data visualizations Priscilla Vazque. All other photos sourced from https://www.wpi.edu/offices/marketina-communication.

