



The University of Akron  
**Biomimicry Research  
and Innovation Center**

# **BIOMIMICRY FELLOWSHIP PROGRAM**



G R E A T L A K E S  
B I O M I M I C R Y

## ABOUT

The Biomimicry Fellowship Program was launched in 2012 by The University of Akron's (UA) [Biomimicry Research and Innovation Center \(BRIC\)](#), in collaboration with [Great Lakes Biomimicry](#). The mission of the program is to provide interdisciplinary training in biology, design, engineering and business to next generation innovators. The vision is for biomimicry to become a driver for economic development in Northeast Ohio and beyond.

Biomimicry Fellows are UA doctoral students who are supported through industrial assistantships with organizational sponsors, rather than through teaching assistantships or research grants. Over the course of a typical five-year doctoral program, Biomimicry Fellows dedicate up to 20 hours per week to advancing biomimicry initiatives within their sponsoring organizations. Intellectual property originated, conceived or made as part of the Biomimicry Fellow's activities with the sponsor is owned by the sponsor.

To be eligible for a Biomimicry Fellowship, an individual must be admitted with intent to enroll in a doctoral program at UA. Oftentimes, a prospective Biomimicry Fellow will apply for admission to an academic program, and for a Biomimicry Fellowship, in parallel. Students in the first year of a doctoral program at UA may also be considered for Biomimicry Fellowships. To date, all Biomimicry Fellows have enrolled in UA's integrated bioscience and polymer science doctoral programs, but other tracks are possible.

## SPONSORSHIP

The organizational sponsor develops a recruiting profile with the assistance of BRIC's director of external relations. Applications of prospective Biomimicry Fellows who meet the relevant program's admission requirements are reviewed in consultation with the sponsor. Interviews are arranged with short-listed candidates. When the position is filled, an advisory committee composed of faculty mentors and, often, a representative of the sponsoring organization is constructed to guide the student through research plan development and execution.

A Year 1 onboarding initiative, the **Biomimicry Jump Start Program**, managed by Great Lakes Biomimicry with support from BRIC, accelerates fellow integration at the sponsoring organization via seminars, discovery meetings and a workshop.

- Seminars: Organization-wide socialization of biomimicry via a lunch hour presentation; deeper education for executives and personnel working directly with the fellow
- Discovery meetings: Dialogue about historically successful approaches to utilizing a fellow; high-level discussion of sponsor's R&D goals to help identify potential entry points for biomimicry; regular check-ins to assess the fellow's progress and troubleshoot issues
- Workshop: Hands-on experience with biomimicry tools that support various stages of the process (e.g., cataloging functions, identifying biological models, extracting design principles)

Fellows and sponsors become members of Great Lakes Biomimicry's **Corporate Innovation Council**. Membership provides the sponsor with valuable knowledge and connections, special workshops and shared resources. During biannual meetings, sponsors share the ways biomimicry brings value to their organizations, e.g., generating intellectual property, embedding non-traditional thinking into teams, adding talent, creating sustainable value and providing access to biomimicry tools. Members learn from one another's challenges and successes, tap into a robust biomimicry ecosystem in Northeast Ohio, and hear from cutting-edge researchers and practitioners in the field of biomimicry. Through the Corporate Innovation Council, Great Lakes Biomimicry supports each company's unique journey as a leader in this new field.

**"If you're not incorporating the most brilliant ideas from the natural world into what you sell, you're leaving money on the table."**

- Fortune magazine (March 2017)

## COST

The current cost to sponsor a fellow is \$191,071 for the typical five years. Below is an annual cost breakdown.

	Before student passes candidacy exams and proposal defense	After student passes candidacy exams and proposal defense*
<b>STUDENT STIPEND**</b>	\$ 21,500	\$ 23,500
<b>FRINGE BENEFITS***</b>	\$ 1,183	\$ 1,293
<b>ADMINISTRATIVE FEE****</b>	\$ 5,898	\$ 6,446
<b>BIOMIMICRY JUMP START PROGRAM (YEAR 1)</b>	\$ 12,850	N/A
<b>CORPORATE INNOVATION COUNCIL MEMBERSHIP</b>	\$ 6,000	\$ 6,000
<b>APPROXIMATE ANNUAL TOTAL</b>	<b>\$ 47,431 Year 1 and \$ 34,581 thereafter</b>	<b>\$ 37,239</b>

\*When the student passes the candidacy exams and proposal defense, the student stipend increases by \$2,000 for subsequent contract years. Typically, a student will achieve these milestones in Year 3, resulting in an increased rate for Years 4 and 5.

\*\*The stipend must meet the minimum set by the college in which the student will pursue a doctoral degree. The figures in the table above assume enrollment in the Integrated Bioscience Ph.D. Program (Buchtel College of Arts and Sciences), historically the most popular track for Biomimicry Fellows; but fellowships have been awarded to students enrolling in other Ph.D. programs, such as polymer science (College of Polymer Science and Polymer Engineering, the minimum stipend for which is \$25,000).

\*\*\*The fringe benefits rate for Graduate Assistants is 5.5% of the student stipend and covers the University's Medicare contributions, retirement contributions and workers' compensation policy.

\*\*\*\*The administrative fee is 26% of the sum of the student stipend and fringe benefits, and covers University overhead associated with administering sponsored projects (Human Resources, Office of Research Administration, Payroll, Purchasing, Provost, Student Services, etc.).

The University of Akron bills quarterly (mid-September, -December, -March, and -June) for the student stipend + fringe benefits + administrative fee. Great Lakes Biomimicry bills annually for Corporate Innovation Council membership and includes the cost of the Biomimicry Jump Start Program in the Year 1 bill.

## CURRENT FELLOW RESEARCH TOPICS

**REBECCA EAGLE-MALONE** | Cleveland Metroparks Zoo

Rebecca, from Ohio, is investigating the connection between biomimicry education and conservation actions. She also studies vascular plant tolerances to determine viability for growth on Mars.

**SARAH HAN** | The Goodyear Tire & Rubber Co.

Sarah, from California, is investigating arthropod tissue and structure's influence on biomechanics, especially rapid motions, assessed using high-speed videography.

**STEPHEN HOWE** | Bendix Commercial Vehicle Systems, LLC

Stephen, from California, is investigating fish maneuverability. Results could be useful in simplifying the control of autonomous and remotely operated underwater vehicles.

**BANAFSHEH KHAKIPOOR** | Teaching Institute for Excellence in STEM

Banafsheh, from Iran, is applying artificial neural networks for prediction of harmful algal blooms (HABs) and dead zones in Lake Erie. She is also part of a team developing a DIY Spectrometer and associated smartphone app allowing amateur scientists to measure and map phosphorus and nitrogen levels in Lake Erie. Banafsheh is also integrating biomimicry in K-12 curricula, helping students rediscover nature while learning about math, physics and programming.

**DANIEL MAKSUTA** | Kimberly-Clark Corp.

Daniel, from Ohio, is using biomimicry for diaper innovation and investigating how to improve products with solutions that deviate from the typical cost-benefit curve.

**SARAH MCINERNEY** | The J.M. Smucker Co.

Sarah, from Ireland, is investigating the hurdles industry faces during adoption and implementation of biomimicry. She is exploring biomimicry's effect on workforce alignment with corporate sustainability initiatives, applying biomimicry thinking to sustainable packaging design and developing models for industry collaboration with museums/zoo's to enable access to biological expertise.

**ARIANA RUPP** | Nottingham Spirk

Ariana, from Portugal, is investigating thermal systems inspired by leaf morphology and evapotranspiration to inform design of multi-scale heat transfer devices for industrial, architectural or makerspace application.

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## CURRENT FELLOW RESEARCH TOPICS

(CONTINUED)

### **DEREK SCHWARZ** | *PolyOne Corp.*

Derek, from Ohio, is applying his polymer and biochemical expertise to a variety of PolyOne interest areas, including innovative material development.

### **KELLY SIMAN** | *Cleveland Water Alliance*

Kelly, from Ohio, is working to improve coastal ecosystem resiliency and land use impacts on Lake Erie and other nearshore waterways while boosting water innovation in the region. Her research focuses on biomimetic applications that support long-term system resiliency, moving away from "random acts of restoration" to a holistic, data-driven approach to management.

### **LAMALANI SIVERTS** | *Avon Lake Regional Water*

Lamalani, from California, is tracking the biogeochemistry between phytoplankton and zebra/quagga mussels in communities that experience harmful algal blooms (HABs) to zero in on HAB-predictive signals in this complex food web which could be detected with inexpensive sensors. She is also bringing water quality awareness to the education system through STEM projects for middle and high school students.

### **ELENA STACHEW** | *Biohabitats*

Elena, from Michigan, is using biomimicry to inform ecological design of coastal stabilization, restoration and urban stormwater management practices through prototyping, design and process integration.

### **BERND STEKLIS** | *Tremco Inc.*

Bernd, from Arizona, is investigating various forms of adhesion for practical use in industry and to improve efficiency and sustainability in factory settings.

### **ADRIAN TWEEN** | *Eaton Corp.*

Adrian, from Mexico, is studying natural materials to gather insights that could inspire advanced structures (e.g., acoustic, adaptable, high strength, lightweight) or materials (e.g., composite, smart).

### **COLLEEN UNSWORTH** | *NASA Glenn Research Center*

Colleen, from Michigan, is investigating the biomechanics of snake and myriapod locomotion to gather insights for design of mobility assistance technologies. She is also exploring the potential for biomimicry to contribute to inclusive design practices.

### **MICHAEL WILSON** | *The Lubrizol Corp.*

Michael, from Tennessee, is investigating the role of functional groups in caddisfly larvae underwater adhesion.

### **HOPE ZIMMERMAN** | *STERIS Endoscopy*

Hope, from Ohio, is exploring different biological models from a mechanical perspective to extract insights relevant to design of medical technologies.

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## PAST FELLOW RESEARCH TOPICS

### **EMILY KENNEDY** | *Class of 2017, GOJO Industries, Inc.*

Emily, from Massachusetts, applied biomimicry to R&D of energy-efficient soap dispensers, protective topical treatments, versatile dispenser brackets and infection control products/processes. Her dissertation made a case for biomimicry in business, providing empirical rationale for reimagining R&D.

### **BOR-KAI "BILL" HSIUNG** | *Class of 2017, The Sherwin-Williams Co.*

Bill, from Taiwan, studied structural color in spiders. Study of non-iridescent blue tarantulas informed design of electronic displays and non-toxic, non-fading colorants. Super-iridescent rainbow peacock spiders inspired a method for separating light into its composite colors with unprecedented efficiency, which may further advance miniaturization of optical instruments.

### **DAPHNE FECHHEYR-LIPPENS** | *Class of 2017, Parker Hannifin Corp.*

Daphne, from Belgium, studied UV-reflective properties of calcium carbonate-based biomaterials, like avian eggshells, to provide insights for developing industrial materials that don't degrade in sunlight, and building envelopes that reflect incident light, keeping occupants cool and reducing air conditioning expenses.

### **SEBASTIAN ENGELHARDT** | *Class of 2019, Ross Environmental Services, Inc.*

Sebastian, from Germany, investigated wastewater desalination and purification inspired by biological processes, such as active trans-membrane water transport by aquaporin protein channels.

## BRIC FACULTY

BRIC has an extended network of 40+ faculty. These faculty members have appointments across campus in the Buchtel College of Arts and Sciences (BCAS), College of Business Administration (CBA), The LeBron James Family Foundation College of Education (LJFFCOE), College of Engineering (COE), College of Polymer Science and Polymer Engineering (CPSPE), School of Law (Law), and Wayne College (WC).

NAME, BRIC ROLE	COLLEGE	DEPARTMENT	RESEARCH INTERESTS
Dr. Steven Ash, Associate	CBA	Management	human resources; organizational behavior
Dr. Henry Astley, Core	BCAS; CPSPE	Biology; Polymer Science	biomechanics of animal locomotion; testing motion and control theories with custom-built robots
Dr. Hazel Barton, Associate	BCAS	Biology	microbial interactions and adaptations to nutrient limitation, as experienced by ecosystems in deep subsurface cave environments
Dr. Carolyn Behrman, Associate	BCAS	Anthropology	urbanization processes as they relate to gender, health, power, and poverty
Dr. Todd A. Blackledge, Core	BCAS	Biology	how biological materials facilitate organismal function during the diversification of behaviors; spider silk, from molecular structure to evolutionary ecology
Dr. Amanda Booher, Associate	BCAS	English	medical and scientific rhetoric; medical humanities and bioethics; theories of bodies, genders, and (dis)abilities; cyborgs, somatechnics, and post-humanism
Kate Budd, Associate	BCAS	Art	tiny carved wax and bronze sculptures that reference organic forms and ancient artifacts
Dr. Alper Buldum, Associate	COE	Mechanical Engineering	computational materials science; mechanical, electronic, and transport properties of nanomaterials; nanotechnology; nanotribology; modeling of advanced materials for energy storage and conversion
Dr. Ali Dhinojwala, Core	CPSPE	Polymer Science	understanding the physical properties of molecules at surfaces and interfaces; adhesion, friction, wetting; structural color
Dr. Zhong-Hui Duan, Associate	BCAS	Computer Science	fast algorithms and scientific computation; bioinformatics; computational biology
Dr. R. Joel Duff, Associate	BCAS	Biology	using molecular genetics tools to investigate organismal and genetic biodiversity
Dr. Stephen Duirk, Associate	COE	Civil Engineering	total water infrastructure sustainability
Dr. James Eagan, Associate	CPSPE	Polymer Science	synthesis of new polymeric materials for sustainable applications
Dr. Joelle D. Elicker, Associate	BCAS	Psychology	learning; feedback; organizational justice
Dr. Patrick H. Gaughan, Associate	Law	Law	innovation; entrepreneurship
Dr. Petra Gruber, Core	BCAS	Art; Biology	spatial and functional aspects of biological structures for biomimetic innovation in architecture and the built environment
Dr. Angela Hartsock, Associate	WC	Biology	bacterial ecology of energy systems with a focus on waters associated with natural gas drilling; genetics of denitrifying physiology in bacteria
Dr. Gary Holliday, Associate	LJFFCOE	Curricular & Instructional Studies	middle level and AYA science
Dr. John Huss, Associate	BCAS	Philosophy	philosophy of science, philosophy of biology, ethics, and philosophy of popular culture — especially philosophical implications of metagenomics/microbiome research, and attempts to reconstruct the geologic and evolutionary past
Dr. Li Jia, Associate	CPSPE	Polymer Science	transition metal-catalyzed polymerizations and carbonylations; supramolecular elastomers and micelles; synthesis of polymeric electronic and optoelectronic materials; soft lithography via nanoparticle self-assembly
Dr. Abraham Joy, Associate	CPSPE	Polymer Science	synthesis and applications of peptidomimetic biomaterials (polyesters, polyurethanes, poly(ester urethane)s); development of stimuli (light, non-covalent interactions, mechanical) responsive polymers
Dr. Hunter King, Core	CPSPE; BCAS	Polymer Science; Biology	mechanical mechanisms organisms use to manipulate and couple with their environments
Matthew Kolodziej, Core	BCAS	Art	paintings exploring the transitory quality of space and perception; intersections between art and science
Dr. Lingyun Liu, Associate	COE	Chemical, Biomolecular, & Corrosion Engineering	anti-biofouling materials; biomaterials and tissue engineering; materials science

NAME, BRIC ROLE	COLLEGE	DEPARTMENT	RESEARCH INTEREST
Dr. Richard Londraville, Associate	BCAS	Biology	molecular and evolutionary biology of fat in zebrafish, lizards, birds, and whales
Dr. Francis Loth, Associate	COE	Mechanical Engineering; Biomedical Engineering	fluid dynamics of biological flows — especially their importance in the development, progression, and diagnosis of disease
Dr. Christopher M. Miller, Core	COE	Civil Engineering	drinking water plant operations-optimization using machine learning, water quality modeling, and collective intelligence
Dr. Randy Mitchell, Associate	BCAS	Biology	evolutionary ecology of plant pollinator interactions — especially how plant mating patterns and success are affected by pollinator behavior and abundance; wetland and restoration ecology
Dr. Chelsea Monty-Bromer, Associate	COE	Chemical, Biomolecular, & Corrosion Engineering	micro-scale sensors using biological mimics for the detection of toxic compounds; biomimicry for non-biological inhibition-based sensors in order to chemically amplify the response from various toxic compounds
Dr. Francisco (Paco) Moore, Associate	BCAS	Biology	evolutionary consequences of gene-gene interactions; theoretical population genetics; experimental evolution in bacteria; interface between micro and macro evolution; evolution of novelty
Dr. Gopal Nadkarni, Associate	COE	Mechanical Engineering	manufacturing and materials; product and design engineering; technology-based startups
Dr. Peter H. Niewiarowski, Core	BCAS	Biology	how the environment affects the physiology and population biology of salamanders and lizards; gecko adhesion
Dr. Amir Nourhani, Core	COE; BCAS	Mechanical Engineering; Biology	fluid dynamics and soft matter with a focus on microrobots and autonomous mechanosensors for potential biomedical, environmental, and energy applications
Dr. Nita Sahai, Associate	CPSPE	Polymer Science	human and bacterial cell interactions with biomaterials and minerals; interfacial chemistry; bone-tissue engineering; biomineralization; origin and early evolution of life; relationship between molecular-level, nanoscale, and macroscopic properties
Anthony Samangy, Associate	BCAS	Art	designing user experiences through time-based or interactive narrative
Dr. Shiva Sastry, Associate	COE	Electrical & Computer Engineering	automation; networked embedded systems; graph algorithms; software systems architectures; modeling; verification
Dr. Marnie M. Saunders, Associate	COE	Biomedical Engineering	orthopedic biomechanics; bone biomechanics; bone cell mechanobiology; lab-on-a-chip and organ-on-a-chip platforms
Dr. Adam W. Smith, Associate	BCAS	Chemistry	molecular organization and dynamics in biological membranes; membrane receptor clustering and its role in signaling; lipid-protein interaction dynamics
Dr. Kwek-Tze (K.T.) Tan, Associate	COE	Mechanical Engineering	impact, damage, and fracture of composite materials; wave propagation in acoustic metamaterials; unique behavior of mechanical metamaterials; bioinspired structures and materials
Dr. Mesfin Tsige, Associate	CPSPE	Polymer Science	computational polymer science and soft condensed matter physics; structure and dynamics of molecules at surfaces and interfaces; elastic and failure behavior of thermosetting polymers; molecular transport through nanostructured materials; interaction of water with surfaces
Markus Vogl, Associate	BCAS	Art	multiple sensory experiences combining sound, environments, and interactive installation
Dr. Stephen Weeks, Associate	BCAS	Biology	delineating the factors favoring the evolution of hermaphroditism from dioecy in animals; evolution of mating systems in crustaceans; mating behavior of clam shrimp; human impact on invertebrate communities in freshwater environments
Dr. Chrys Wesdemiotis, Associate	BCAS	Chemistry	fundamental studies and analytical applications of mass spectrometry and tandem mass spectrometry to macromolecules; synthetic polymers; biopolymers
Dr. Anne Wiley, Associate	BCAS	Biology	using stable isotopes and other tools to study the ecology of modern and ancient animal populations; population ecology and human-mediated changes in animal diet and distribution with focus on seabirds
Dr. Yingcai (Tom) Xiao, Associate	BCAS	Computer Science	computer graphics and visualization; numerical simulation and applications

## SPONSOR TESTIMONIALS

“Biomimicry gives Nottingham Spirk a whole new way to approach brainstorming and product development while solving design and engineering problems. Nature is so vast that we will never run out of possible inspirations. Now, the first question that we ask in our innovation process is, ‘How would nature handle this issue?’”

- **JOHN NOTTINGHAM**, Co-President of Nottingham Spirk

“Studying and emulating biological systems as ideation stimulus sparked totally new approaches to the design challenge. Many of the solutions we came up with would use far less energy than our current technology, which is not surprising because when you think about it, nature is resource-efficient by necessity.”

- **TOM MARTING**, Facilities, EH&S, and Sustainability Director at GOJO Industries, Inc.

“Biomimicry is an innovation method Kimberly-Clark uses for developing new materials to enable business plans and sustainability goals. Discovering and translating nature’s strategies helps us open our perspective and solution space when looking for a new approach or benefit to a product, or to tackle a challenge that hasn’t been solved with traditional methods.”

- **CLAY BUNYARD**, Research Technical Leader at Kimberly-Clark Corp.

## CONTACTS

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