



Emergent Mechanisms in Biology of
Robustness, Integration & Organization

Emergence: A biweekly newsletter of discovery, education, and outreach from the EMBRIO Institute

Issue 26: November 17, 2023

DIRECTORS' NOTE

As we approach the Thanksgiving holiday next week, we wish everyone a relaxing break, and safe travels. However, don't miss our next EMBRIO seminar this coming Monday, November 20th; Dr. Weiwei Zhang in the Staiger Lab will present a research seminar titled **Decoding Ca²⁺ signatures and signaling to the actin cytoskeleton during the plant innate immune response**. This work in Thrust 2 that Dr. Zhang is presenting includes collaborations with multiple EMBRIO labs that are working with the Staiger lab to develop data analysis tools and mathematical models.

If you missed the all-hands session featuring the intro tutorial on VCell by Dr. Michael Blinov with the Center for Cell Analysis and Modeling at UConn Health, you can access the video in our Box account under the "All-Hands Meetings Recordings" folder ([direct link to the VCell session](#)).

A note especially to Purdue labs regarding EMBRIO travel funds: For the faculty, staff, and trainees, please complete the [Request for Travel Funds application](#) well ahead of your planned conference(s). A new policy and heads-up to trainees: to gain access to EMBRIO travel support funds it is necessary to describe how the conference will aid your professional development, as well as document your participation in Institute activities. Regular and sustained participation in Institute activities *is necessary* for travel funds approval.

There are several upcoming public seminars being presented by trainees from EMBRIO labs. Please check out the Upcoming Deadlines, Important Dates, and Info section below. A thank you to Feyisayo Akande (Staiger Lab) for serving as President of the EMBRIO Student Leadership Council, and hearty shout of support as she presents her thesis research next Tuesday (zoom link available below), **Investigating the role of *atpiezo* as a possible mechanoreceptor during plant defense**.

If you are new to EMBRIO (or want a refresher), we recommend that you take a look at the resources on the shared Box account in the [Orientation to EMBRIO](#) sub-folder. We will dedicate an all-hands session in the spring to this topic.

Purdue labs looking/planning for undergraduate researchers now or next summer (*and our partner institutions who have students who want to come to Purdue for a summer research experience*), Brent has been in touch with the Engineering Undergraduate Research Office about next steps. See the info from Kay Kobak, their new Assoc. Director in this issue.

We want to hear about your news and announcements. Send them to Brent (laddb@purdue.edu) by December 1st for inclusion in the next issue of *Emergence*.

David, Chris, Stephanie, Anjali, Janice, Jeremy, and Brent

Notable Quote

"Any knowledge that doesn't lead to new questions quickly dies out: it fails to maintain the temperature required for sustaining life. This is why I value that little phrase "I don't know" so highly. It's small, but it flies on mighty wings. It expands our lives to include the spaces within us as well as those outer expanses in which our tiny Earth hangs suspended." ~ Polish poet **Wisława Szymborska** (July 2, 1923–February 1, 2012); from Nobel Laureates acceptance speech.

QUICK LINKS

[All-Hands Meetings Recordings](#)

[Orientation to EMBRIO](#)

[ABIDES Culture and Mentoring resources](#)

Undergraduate Researchers Opportunities for EMBRIO Labs and Students

Note from Kay Kobak, Assoc. Dir., EURO, Purdue:

Hello Undergraduate Research Allies,

We will also be asking for SURF applications in the coming weeks, so begin to think about your Summer 2024 needs now.

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Program Name	Description	Student Compensation	In-Lab Time Commitment	Funding provided by	Call for applications*
Summer Undergraduate Research Fellowships (SURF)	Summer program for both Purdue Internal and external students, full time research experience.	A total of \$6000 paid over 12 weeks.	30-40 hours/week	Cost shared 1:1:1 between EURO, the College, and the lab. (EMBRIO Note: the Institute will pay the PI tab of \$2K, plus the \$1K housing stipend if a non-Purdue student)	Summer 2024 cohort proposals to open in November
OUR Scholars	Full-time undergraduate researcher for TWO semesters.	\$1000 scholarship (\$500/semester)	By agreement with faculty	Cost shared between OUR and the College	Fall 2023/Spring 2024 application closed.

First Year Investigator's Program (Office of Undergraduate Research)	Fall semester program for First-Year students.	\$15/hour	6-10 hours/week	Office of Undergraduate Research	Fall 2023 application closed
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**if you have already identified a student you wish to work with for a given time period, we still ask you post the project so we can maintain that information for our records. We can expedite the selection process and then close the project to other applicants if you already have someone in mind.*

Additional opportunities if you're currently hosting undergraduate researchers:

[EURO Travel Grant](#): For Purdue affiliated undergraduates who will be presenting their research at a conference - \$500 awarded by EURO

[OUR Fall Expo](#): While the abstract deadline has passed for those wishing to give a talk, undergraduate researchers can still request to present virtually or give a poster Nov. 14-21.

Other undergrad researcher funding opportunities can be found [here](#), [here](#), and [here](#).

Please feel free to reach out if you have any questions,

Kay Kobak, Ph.D.

she, her, hers

Associate Director, Engineering Undergraduate Research Office

DUDL 2526 | o.765-496-2349 |

STUDENT LEADERSHIP COUNCIL CORNER

The SLC is recruiting new officers to represent your university and your perspective for EMBRIO. Reach out to David Gazzo (dgazzo@nd.edu), incoming president, for more information, and [log your ideas for future topics or events](#) that the SLC could organize. [Access SLC slides and documents](#), and consider [signing up to give or receive mentoring](#) for/from EMBRIO trainees in helping support and orient to the EMBRIO mission and interdisciplinary framework.

EMBRIO ABIDES (Access, Belonging, Inclusion, Diversity, Equity, Support)

Dr. Anjali Iyer-Pascuzzi, EMBRIO ABIDES Director and Professor at Purdue, leads activities for Institute members. A series of mentoring topics have been presented at the beginning of Weekly meetings, and a continuation of the Mentoring Panel topics from the annual retreat was presented October 23rd during the EMBRIO Weekly with a deeper dive into how culture impacts our mentoring and team thinking.

BTW, if you missed “The role of culture and communication in mentoring” mini-workshop – [view it here](#), or the previous “mentoring snacks” check out the slides and resources in the ABIDES > [Mentoring folder](#), and listen to “[The Secret of Great Teams](#)” episode of The Hidden Brain podcast.

JOURNAL CLUBS

Journal Club on Calcium Imaging Techniques meets Monday's 11am ET

Due to the need within our EMBRIO community to process and analyze Ca²⁺ Images, Dr. Norma Perez Rosas (nperezro@purdue.edu) is helping lead this club in discussing papers regarding methods and tools for analyzing calcium imaging. **The goal, beyond integrating these techniques, is to write a review paper.** The Club is meeting weekly on Mondays at 11am. Please contact Norma about participating.

Journal Club on Multimodal Functions of Calcium in Tuning and Regulating Cytoskeleton Networks

Please contact Dr. Linlin Li (li2212@purdue.edu) for information. The club is in the writing stage for organizing and publishing a review paper on the topic. It isn't too late to join. Here is the link to the current working documents:

https://docs.google.com/document/d/1Cpg77ytioWiluRmiDMCcAiAd4jNNX_J7s64RQk8xOU/edit?usp=sharing

EMBRIO SUMMER WORKSHOP RESOURCES

EMBRIO Institute's 2nd Annual Summer Training Workshop took place July 10-12. [Workshop Schedule of Sessions](#). Hosted by Dr. Jeremiah Zartman at the University of Notre Dame with a theme of *Image Acquisition, Processing, and Analysis*, tutorials and hands-on sessions were specifically aimed at benefiting trainees from both computational and experimental domains. Slides, handouts, and video recordings from this workshop are available on our shared Box account: <https://app.box.com/s/mzo5ihlqiq4tfeig2psx2l6rmdxto0c>

EMBRIO ALL-HANDS ANNUAL RETREAT MATERIALS

EMBRIO Institute's Annual Retreat was hosted in the Weldon School of Biomedical Engineering on the Purdue University West Lafayette Campus, July 13-14, 2023. The annual retreat brought together the large majority of EMBRIO members in one physical place, with more than 60 of us engaging in research talks, poster presentations, programmatic discussions, and informal gatherings. Slide decks and posters from the annual retreat can be accessed here: <https://app.box.com/s/rmsiuvydlsccezhugyjp2b5v72xl9l>

UPCOMING DEADLINES, IMPORTANT DATES, & INFO

EMBRIO All-hands Meeting Schedule, Monday's 3-4pm ET. [Zoom link](#). [Weekly Update Meeting Recordings](#)

Aug	14	Benchling Workshop - SLC (Feyisayo)
Aug	21	Student Leadership Council - Grads and Postdocs Only Session
Aug	28	Faculty Investigators Only
Sept	4	Labor Day no meeting
Sept	11	Dr. Linlin Li: Part I: Solving mathematical modeling with ODE or PDE in MatLab or Python (Google Colab)
Sept	18	Dr. Linlin Li: Part II: Solving mathematical modeling with ODE or PDE in MatLab or Python (Google Colab)

Sept	25	Dr. Adrian Buganza Tepole: Part I: Physics informed machine learning
Oct	2	Dr. Adrian Buganza Tepole: Part II: Physics informed machine learning
Oct	9	Fall Break - no meeting
Oct	16	Open Discussion and Thrust Project Breakout Rooms
Oct	23	ABIDES: Culture, Mentoring, & Teams Mini Workshop
Oct	30	No meeting. Thrust Leads organize own meetings
Nov	6	VCell tutorial by Dr. Michael Blinov, Center for Cell Analysis and Modeling, UConn
Nov	13	No meeting. Thrust Leads organize own meetings
Nov	20	Dr. Weiwei Zhang, Staiger Lab, Thrust 2 Integrations
Nov	27	No meeting. Thrust Leads organize own meetings
Dec	4	Javier Muñoz (Brubaker/Green Lab)
Dec	11	No meeting. Thrust Leads organize own meetings
		Winter Break

November 20, 2023. EMBRIO All-Hands. Decoding Ca²⁺ signatures and signaling to the actin cytoskeleton during the plant innate immune response. This work in Thrust 2 that Dr. Zhang is presenting includes collaborations with multiple EMBRIO labs that are working with the Staiger lab to develop data analysis tools and mathematical models.

Decoding Ca²⁺ signatures and signaling to the actin cytoskeleton during the plant innate immune response

Abstract

Plants have evolved conserved molecular mechanisms to recognize microbe-associated or damage-associated molecular patterns (MAMPs or DAMPS), mechanical perturbation, and/or cell wall integrity changes to initiate the first layer of defense response known as pattern-triggered immunity or PTI. During the first few minutes of PTI, several hallmark cellular responses occur including influxes of Ca²⁺ into the cytosol, accumulation of the signaling lipid phosphatidic acid, a transient reactive oxygen species (ROS) burst, and remodeling of the actin cytoskeleton. Among these hallmark events, cytosolic Ca²⁺ signals are recognized as a key early signaling element as they are highly specific in duration, amplitude, and frequency, and therefore encode specific information and trigger distinct downstream signaling pathways in response to different stimuli. Despite their obvious importance, Ca²⁺ signatures and how they spread in space and time in response to different stimuli during PTI have not been carefully characterized nor are the molecular mechanisms encoding these spatiotemporal Ca²⁺ signatures well understood. In this work, we developed an image acquisition and analysis pipeline to study plant defense related Ca²⁺ dynamics in Arabidopsis cotyledon epidermal cells using the live cell calcium biosensor R-GECO1. We characterized both single-cell Ca²⁺ signatures as well as intercellular Ca²⁺ wave patterns in response to two types of stimuli that mimic pathogen attack: global chemical stimulation with MAMPs and local mechanical stimulation by single-cell laser ablation. In addition, we show that pre-disruption of the cortical actin cytoskeleton resulted in altered single-cell Ca²⁺ signatures and increased calcium signaling durations, suggesting a negative feedback mechanism between the actin cytoskeleton and calcium signaling during PTI. Our work will help understand the calcium signaling mechanisms as well as the spatial spread of immune signals across a tissue during plant defense against pathogens.

November 21, 2023 Investigating the role of *atpiezo* as a possible mechanoreceptor during plant defense. In-Person WSLR 116, 9:30 AM. Zoom: <https://purdue-edu.zoom.us/j/97Ql336OQ27> Presented by Feyisayo Akande (Staiger Lab), Botany & Plant Pathology Special Seminar (in partial fulfillment of requirements for the Master of Science degree).

Abstract:

Plants are capable of perceiving and responding to biotic and abiotic stress. They have evolved a variety of mechanisms to help them recognize and trigger rapid responses to both chemical and mechanical stimuli. In this study, we investigated the potential role of PIEZO, a mechanosensitive ion channel that is responsible for cellular mechanotransduction in both the plant and animal kingdoms, in plant immune responses. Publicly available RNAseq data revealed that *PIEZO* expression remained constant and unaltered in response to a variety of phytopathogens or elicitors. We, then, conducted infectious growth assays on *piezo* mutants in *Arabidopsis thaliana* plants. Our results indicated that *piezo* mutants, *pzo1-1* and *pzo1-5*, were more susceptible to *Pseudomonas syringae* pv. tomato (Pst) DC3000 and the *P. syringae* hrcC-mutant confirming PIEZO's role in plant defense and PTI. We further explored disease progression with necrotrophic fungi, *Alternaria brassicicola* and *Botrytis cinerea*, on *Arabidopsis thaliana* plants and found enhanced fungal growth compared to the wild type (Col-0) with *Botrytis*. Building upon these findings, we probed the role of PIEZO in the growth-defense tradeoff using a root growth inhibition assay with flg22 as MAMP elicitor. *piezo* mutants were less sensitive to flg22 treatment with less reduction in root growth length compared to wild type. In addition, we investigated whether PIEZO is upstream of the main NADPH-oxidase, RBOHD, and the associated oxidative burst that occurs in early defense. There was no significant difference in Reactive Oxygen Species (ROS) production between *piezo* mutants and the wild type in an apoplastic ROS assay with a MAMP elicitor (flg22). In conclusion, we demonstrated a potential role for PIEZO as a mechanoreceptor and mechanosensitive ion channel in plant immune defense responses and the growth-defense tradeoff.

These signals coordinate plant growth, development, and innate immune responses. However, we have limited knowledge about how mechanical signals are perceived and transduced during the plant immune response.

November 22, 2023. Dr. Norma Pérez Rosas, EMBRIO Postdoc, will be co-presenting an online webinar for Plantae, American Society of Plant Biologists, titled: “Shifting to a New Species/Research Subject”. 12pm EST. [REGISTER for the event](#) (free).

Abstract:

Join us for a groundbreaking webinar as we delve into the world of shifting research focus to new species and subjects. In this thought-provoking event, pioneering scientists who have successfully shifted their field of study will share their invaluable insights, experiences, and practical advice. Explore the challenges, opportunities, and ethical considerations involved in this transition, and gain a deeper understanding of how to navigate uncharted territories in your research. Whether you're a seasoned scientist looking to broaden your horizons or a curious explorer of the scientific realm, this webinar will provide you with a unique opportunity to learn from those who have blazed new trails and transformed their scientific journeys. Don't miss this chance to gain fresh perspectives and chart exciting paths in your research endeavors.

November 22, 2023. Novel Mechanisms In Regulating Neutrophil Migration. 3:00 PM, LILY 1-117, Biological Sciences Defense Seminar by Tianqi Wang (Deng Lab).

Abstract:

Tianqi completed his D.V.M. and Master's in veterinary medicine at Huazhong Agricultural University in China. He joined Dr. Qing Deng's lab in 2017, where his research focused on neutrophil migration. Throughout his PhD studies, Tianqi made discoveries related to novel mechanisms governing neutrophil chemotaxis and baseline motility. Beyond his rigorous academic pursuits, Tianqi has a passion for photography, gourmet cooking, playing video games, and enjoying time with his family. Following his graduation, he will continue his adventure in neutrophil research in the context of various human diseases at the Wagner lab in Boston Children's Hospital.

January 2 – 6, 2024. BMES – CMBE Conference. San Juan, Puerto Rico. Conference details: <https://www.bmes.org/cmbe2024>

BII Annual Conference - January 22, 2024 . Details on the agenda will be shared when available. NSF is planning a hybrid one day meeting for all Biology Integration Institutes. Most attendees will be virtual, with a few of us in person at NSF headquarters.

February 6-7, 2024. EMBRIO Thrust & Site Leads Retreat. Thrust and site leads, and key investigators, will engage in two days of thrust and project working sessions in person (and yes, actual retreat social activity, as well). Logistics have been shared with all involved.

March 6-10, 2024. The Allied Genetics Conference (TAGC24). Washington D.C. (Genetics Society of America). <https://genetics-gsa.org/tagc-2024/> Note: EMBRIO is organizing a workshop for this conference. More TBA.

Hot Off the Press: New EMBRIO Journal Papers

Let us know about new papers you want to highlight for the EMBRIO community!

REMINDER: EMBRIO Acknowledgement for Scholarly Papers and Posters.

For EMBRIO related research publications, NSF requires acknowledgement of EMBRIO NSF funding for our Institute to claim the work in our reporting back to NSF. Please include the following acknowledgement in your journal and conference papers and posters: **“This work is based upon efforts supported by EMBRIO Institute, contract #2120200, a National Science Foundation (NSF) Biology Integration Institute.”**

New Lab Members?

Did you recently have new students or staff members join your EMBRIO projects? We want to add them to the listserv, Box account, demographics survey, and Personnel List for ensuring their inclusion in communications and participation. If they are not already on our Personnel spreadsheet (<https://app.box.com/s/frd9275xc069gmtbe3y1osoz1j7ssk7>), or they have graduated, let Brent know their names and email contacts (laddb@purdue.edu)

Submit your items for the next newsletter by **Dec. 1** to Brent (laddb@purdue.edu)