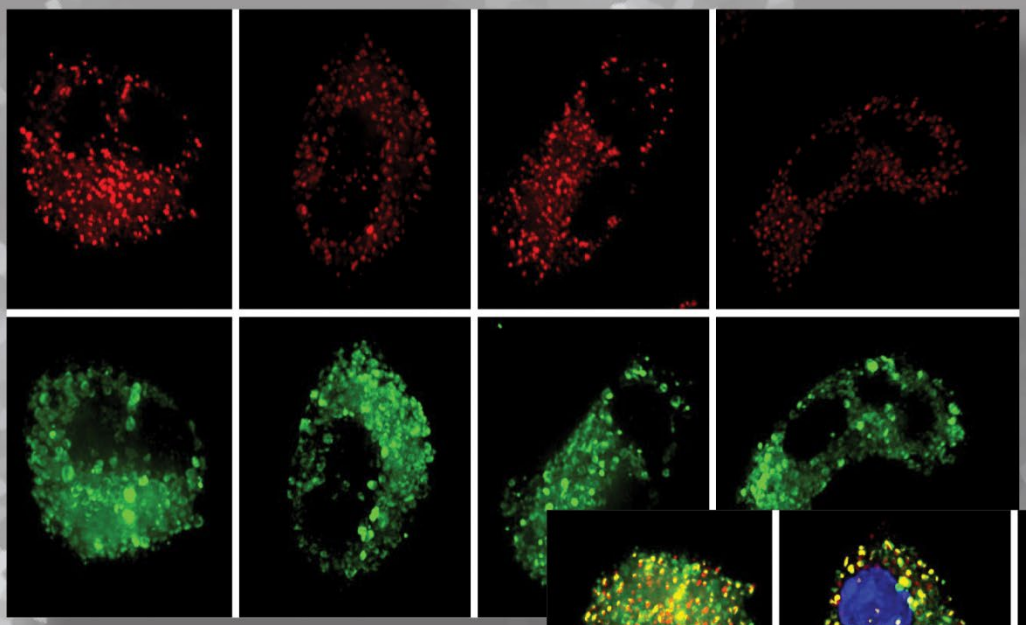
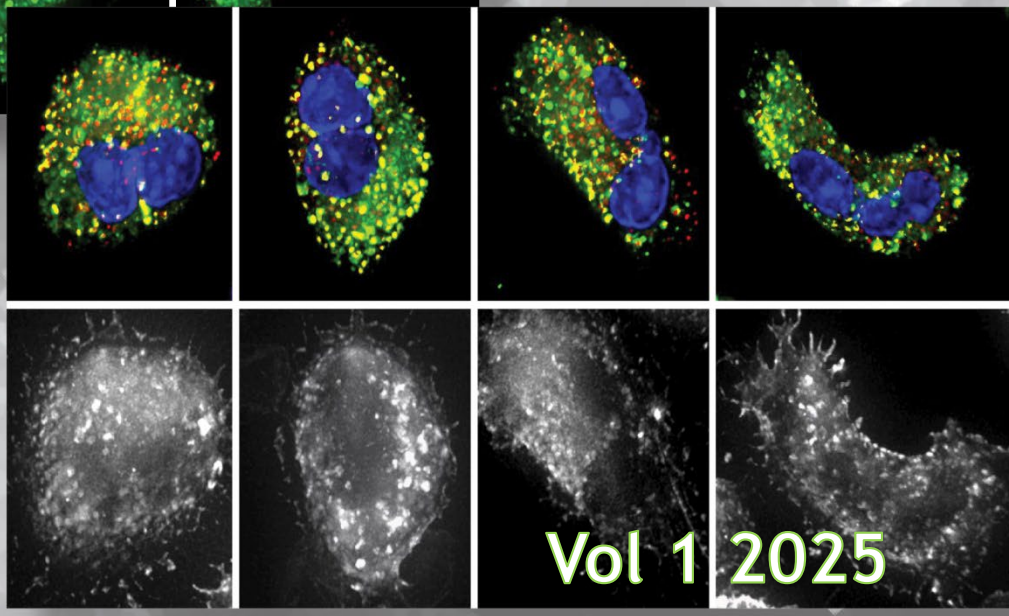




iSLB

SOCIETY FOR LEUKOCYTE BIOLOGY

Vol 1 2025

In this issue...

And don't miss

A Message from the President


Lou Justement

Trying Times for Biomedical Research. I am certain that this statement is not a surprise for anyone reading this message. Since the new administration came into power, it seems that there has been one threat after another against the biomedical research enterprise. I do not use the word "threat" lightly. I use this word intentionally because there really is no other explanation for what we have all witnessed with our own eyes. On January 21st, the administration paused communications across the Department of Health and Human Services (HHS) and days later the Office of Management and Budget (OMB) issued an order that froze payments on all federal grants and loans. This notice was challenged almost immediately and as a result, the OMB rescinded the order on January 29th. On February 7th, the administration instructed the NIH to issue a new notice announcing a 15% Facilities and Administrative (F&A) rate cap for all NIH grants (NOT-OD-25-068), effective immediately. This policy was challenged by two temporary restraining orders and has yet to be enacted. Perhaps most damaging to the research enterprise so far has been the order curtailing posting to the Federal Register, which constitutes yet another strategy intended to circumvent court orders. As a result, virtually no study sections or council meetings can take place and funding for grants is basically frozen.

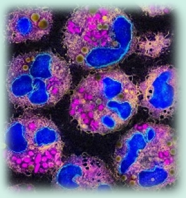
These issues without question pose a significant threat to the future of biomedical research. Add to this the potential for science to be censored if grants contain specific words or have a focus that is in contradiction to the administration's mandates, the fact that 1200 individuals in probationary positions at the NIH were fired, the proposed plan to ban renewing the position of senior scientists at NIH and the recent proposal from the Secretary of HHS to discontinue the 50-year practice of requesting public input into proposed changes at NIH and you have the perfect storm.

Perhaps the most inexplicable and frustrating thing about these recent actions by the administration is that they go against the long-standing reality that support for the biomedical research enterprise has historically been bipartisan. In fact, support for biomedical research has been one of the few things that members from both sides of the aisle have been able to agree upon. In 2016, Representative Tom Cole (R) in the House and Roy Blount (R) on the Senate side worked with appropriations committees in both houses to initiate a long-term increase in support for the NIH; a trend, which continued until recently. Regardless of the past, it seems clear that at this point, bipartisan support can no longer be counted on. One has to question why it is that members of Congress have become complacent about biomedical research and apparently, have ceded their constitutional duty to oversee how taxpayer dollars are allocated at the peril of the NIH and biomedical research across the US. That is a long and complicated discussion for another day.

So, what can each of us do in these trying times? First, we cannot give up hope. Second, we need to reach out to the non-scientific community and educate them about the threats that science currently faces and the negative impact that will have on all of us. Finally, and most importantly, we all need to reach out to our representatives in Congress to let them know the tremendous damage that has been done to biomedical research and that if the work at the NIH does not return to normal, the irreparable damage that will be done. A failure to support the mission of the NIH will damage the US economy, erode the standing of the US in the world as a leader of scientific innovation, and negatively impact the health and wellbeing of everyone in the US. If each of us takes the time to call our representatives, to send them emails and whenever possible visit their offices, we have a chance to try and reverse the damage done. The message we need to send loud and clear is that biomedical research drives economic vitality across the US, that biomedical research is essential to the development of novel diagnostic and therapeutic approaches that save lives, and that biomedical research cannot be replaced by efforts in the private sector. Biomedical research can only be carried out with federal funding and a functional NIH.

SLB's Annual Image Contest

April 29th is the International Day of Immunology! SLB welcomes members to participate in a little fun. Submit an original, self-made, unpublished image in any of these categories and be entered into a prize drawing. Formats accepted include jpegs, gifs, pngs, and pdfs. Entries are being accepted **now through 5pm eastern Friday, April 18th**. Winners to be announced on April 25th in celebration of the International Day of Immunology. Learn more and submit today!


2024 Winner: Rossana Melo

By submitting your image and caption, you give SLB permission to include the images (with credit) in the next issue of iSLB and on the society website.

Curious like Carver

By Mary Oliver

Editor's note: *At the heart of scientific progress lies not just discovery but also the people who make those discoveries possible. Diversity, equity, and inclusion (DEI) efforts are crucial in fostering a scientific community where all voices can thrive, innovate, and contribute meaningfully. This issue, we are honored to feature a deeply personal and timely reflection by my graduate student, Mary Oliver. In her essay, Mary shares her journey into science—one shaped by mentorship, perseverance, and a commitment to making STEM a more inclusive space. Her story reminds us of the importance of representation, community, and the responsibility we all share in cultivating an environment where future generations of scientists, particularly those from underrepresented backgrounds, can flourish. – Julia Bohannon*

I never truly believed I could be a scientist, at least, not at first. If you had asked me as an adolescent about my career aspirations, I would have rattled off a list of familiar choices: doctor, teacher, mother. Looking back, I realize my vision of the future was as limited as my window into the world. My mother was a teacher, and my family doctor was Black woman. I could imagine myself in these roles because I had role models to emulate.

But deep down, my fascination lay elsewhere. If I had answered truthfully, I would have told you that I wanted to be a gardener. Gardening was where my scientific journey began as a child. In my household where my mother nurtured curiosity and encouraged scientific inquiry, I learned that knowledge could be both cultivated and expanded. My mother introduced me and my four siblings to the legacies of Black scientists, including chemist Madam C. Walker, ophthalmologist Patricia Bath, physicist Herman Branson, entomologist Margaret Collins, and astronaut Mae Jemison. But my favorite scientist of all was agriculturalist George Washington Carver.

Carver revolutionized agriculture by promoting nitrogen-fixing crops like peanuts and soybeans to restore depleted Southern soils during the early 20th century. His research on crop rotation saved farmers millions, and his tenure at Tuskegee Institute ensured generations of Black students had access to scientific education. His legacy is one of resilience, ingenuity, and transformation. As winter slowly shifts into spring here in the Southeast, I am reminded of the lessons both gardening and Carver have taught me: of growth through change, the necessity of patience, and the beauty of the unknown.

Stepping onto the campus of Mary Baldwin University (MBU) as a freshman felt like stepping into a new horizon. A small private institution with fewer than 1,000 residential undergraduate, MBU lacked the infrastructure for high-tech lab research. My freshman and sophomore years were spent pouring agar plates for microbiology labs as part of my work-study job. It was tedious, but so is tending to a garden. Patience, I learned, is part of the process.

Carver, too, understood patience. Born into slavery and often too sickly for field labor, he spent his childhood collecting plant specimens instead. Even after the abolition of slavery in Missouri in 1865, education remained out of reach, as no school would accept a Black child. He was eventually homeschooled by Susan Carver, the woman who took him in after his family was lost due to kidnapping. His thirst for knowledge never wavered, and it carried him through every obstacle he faced.

Like seeds waiting to germinate, my own scientific endeavors were slow to take root. But coursework, close faculty mentorship, and time in the lab nourished my scientific curiosity. Under the guidance of Dr. Melissa Scheiber, I developed my first research project, investigating the role of microRNA 200a and phosphatase tensin homolog (PTEN) in monocyte differentiation under immune stress. This project culminated in a poster presentation at the Annual Conference of Southeastern Biologists and a nomination for my university's Capstone Award Carmony.

While research became the foundation of my scientific growth, mentorship was what truly grounded me. STEM historically has been a place where Black students survive but rarely thrive. The higher one climbs in academia, the more isolating it can feel, with shallow support systems, a lack of demographic or racially similar peers, and relentless competition create an environment that stunts, rather than fosters, our growth.

But as in gardening, there is a practice called companion planting – planting certain plants together to support one another's growth. The Haudenosaunee (Iroquois) people developed a method called the Three Sisters, where corn, beans, and squash thrive in symbiosis: beans fix nitrogen into the soil, corn provides a trellis for the beans to climb, while squash shades out weeds to protect the others. Growth, I realized, isn't just about where you're planted, it's about who grows alongside you.

Without the encouragement from my mentor, Dr. Scheiber, a woman in STEM who saw my potential; without my mother, who planted the seed of curiosity; without the diligence of my peers at MBU, I would have floundered. For this reason, I dedicated myself to

mentorship, serving as a peer tutor for first-generation college students, women, single parents, queer, African American, and Latino students. I advocated for their needs, ensure their voices were heard and understood by faculty, and served as secretary and treasurer for my university's TriBeta Biological honors Society. I have also worked directly with the Iota Sigma Pi Women in Chemistry Society to support undergraduate women in STEM.

After graduating I was still convinced I wanted to be a doctor, not scientist. I joined the Firefighter's Burn and Surgical Research Lab (FBSRL) at Medstar Washington Hospital, hoping to gain clinical experience. But while shadowing surgeons, I found my attention drawn elsewhere – to the African American and Latino burn patients at the bedside and to the underlying biological mechanisms behind their conditions. Hypertrophic scarring, a pathology that disproportionately affects people of color, fascinated me. I realized my calling wasn't just to treat patients, it was to uncover the scientific mysteries behind diseases and conditions that affect marginalized communities.

Under the mentorship of Drs. Bonnie Carney and Lauren Moffatt, I gained the confidence to see myself as a scientist. Their belief in me led to several publications, conference presentations, and gave me the courage that I could succeed as a young woman African American scientist. Ultimately, my experience at the FBSRL opened the door to a new opportunity – joining the lab of Dr. Julia Bohannon at Vanderbilt University. Now, as a third-year PhD candidate, I study the immunological consequences of burn injury and trained innate immunity, guided by a mentor who fosters both innovation and inclusion.

Choosing my thesis lab was another lesson from Carver. He became the first Black student at Iowa State University, and later earned his Master's degree before being recruited by Booker T. Washington to lead Tuskegee Institute's agricultural department. The department flourished under Carver's leadership and gained national recognition. His work reshaped agricultural science and uplifted generations of Black students. He didn't just make scientific discoveries; he created opportunities for others to thrive.

Our mobility in science, as in life, is uniquely intertwined with those who came before us. Just as Booker T. Washington saw potential in Carver, I have been fortunate to find mentors who see mine. My commitment to fostering inclusion and diversity has flourished at Vanderbilt University, where I have built community through organizations like the Initiative for Maximizing Student Development (IMSD) and the Organization of Black Graduate and Professional Students (OBGAPS). Dr. Bohannon, who has faced many challenges of her own as a woman in STEM, has made me feel seen, and has encouraged me to push boundaries, seek change, and advocate for equity in and outside of the lab. Our successful mentor-mentee partnership was recognized with the Howard Hughes Medical Institute's Gilliam Fellowship, awarded to student-faculty pairs dedicated to both scientific excellence and inclusive leadership.

My journey is only just beginning and there is so much to be done to make STEM a space where Black and Brown students don't just survive but thrive, where our communities reap the benefits of scientific discovery. My story is unique in that in each stage of my early career I was buoyed by the wisdom of mentors and advocates which allowed me to persevere through struggles. The deep distrust between underrepresented groups and academia, medicine, and science is not unfounded; these institutions have failed them time and again. I am committed to bridging that gap – mentoring the next generation, developing science curricula for elementary students, and engaging with my local community garden. My research on trained innate immunity in burn patients is a small step toward a larger goal: ensuring that marginalized communities receive the scientific attention, care, and advocacy they deserve.

Looking back, I am proud that even in my moments of uncertainty, I remained curious like Carver. If I could speak to my younger self, I would say this:

> Do not fear the unknown. Water the seed planted in you with patience and hard work, and it will germinate. Root yourself in a community that supports your growth. And when the time comes, don't be afraid to bloom – even if you're the only flower in the garden.

Upcoming Webinars

Building Bridges in Leukocyte Biology Series

Juliana Zuliani, *Universidade Federal de Rondônia* will present "**Cr-LAAO, an L-amino acid oxidase from Calloselasma rhodostoma venom, induces FPR-dependent vital NETosis in human neutrophils**" on March 26th, 2025 from 12-1pm eastern.

Learn more and register

Up Next!

April 23rd - Marta Mastrogiovanni, *Albert Einstein College of Medicine*

Engineered Platelets for Biologically Targeted Therapeutics

In preparation for submission to the Society for Leukocyte Biology
Stephanie Hindle1,2*, Alyssa Logan2*, Craig Jenne1, 2
1Department of Microbiology, Immunology and Infectious Diseases, University of Calgary, Calgary, Canada
2Snyder Institute for Chronic Diseases, University of Calgary, Calgary, Canada
*These authors contributed equally

Introduction

Platelets are bone marrow-derived, anucleated cells largely known for their involvement in initiating protective blood clotting as a defence against severe bleeding in an effort to maintain the body's blood volume (1). Although crucial in a state of homeostasis, under pathological conditions, uncontrolled/dysregulated clotting results in thrombosis; a vascular occlusion that impairs blood perfusion and oxygen delivery to vital organs (Figure 1) (2,3). Although recognized for their role in clotting, platelets are also vital immune cells. Through granule-mediated interactions with other platelets, endothelial cells, and immune cells, platelets participate in the pathogenesis of various inflammatory and immune pathologies, including immune-mediated thrombosis, cancer, atherosclerosis, transplant rejection, and infections (4,5). Based on the diversity of platelet activities, inhibiting platelet activation provides an interesting potential therapeutic avenue for in treating disease; however, current antiplatelet therapies are administered orally or intravenously rather than locally, introducing the risk of systemic side effects and potentially negating the protective role of platelets in hemostasis. Critically, this systemic-based application of antiplatelet therapies increases the risk of life-threatening bleeding events (6). This unintended bleeding risk limits our ability to treat thrombotic disease and points to a need for a more targeted approach to treating platelet-mediated immune and inflammatory disorders.

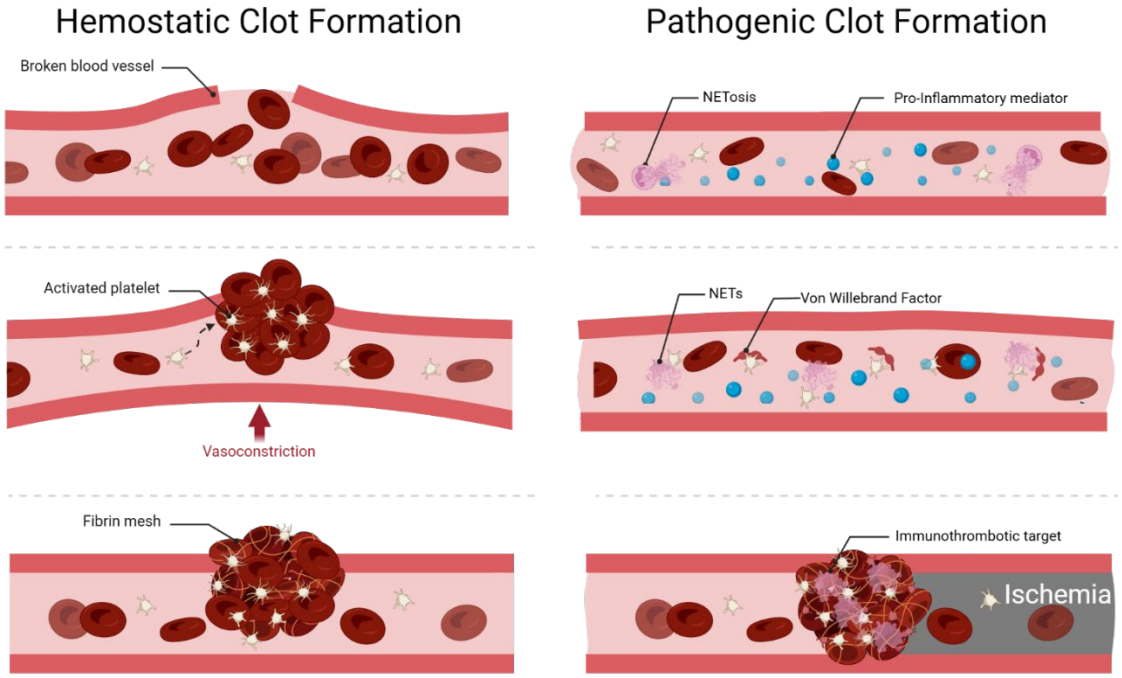


Figure 1: Representative examples of hemostatic and pathogenic clot formation displaying differences in immune activation implication between types of clots, exemplifying a potential therapeutic target (Created using BioRender.com).

Platelets as Immune Cells

Evolutionarily, hemocytes, the primordial platelet in invertebrates with circulatory systems, play a central role in innate immunity; phagocytosing pathogens and facilitating the clotting of hemolymph to trap and sequester bacteria (7,8). In mammals, platelets behave as immune cells through processes such as degranulation, pathogen internalization, and by interacting with other immune cells, either directly through ligand-mediated interactions or indirectly through their release of soluble mediators (9). Following platelet activation, degranulation leads to the release of various molecules that facilitate platelet interaction with other cells, platelet aggregation, and pathogen killing. Platelet activation also initiates blood clotting, which can be protective (hemostatic) or pathogenic (thrombotic) depending on the platelet's environment. Moreover, platelets release numerous cytokines and chemokines that enhance leukocyte activation and recruitment, stimulate endothelial cells, and induce vascular changes, making platelets key contributors to the inflammatory response (10).

Synthetic Platelets as a Novel Therapeutic Option

The emerging field of nanomedicine provides an enticing new direction for treating platelet-mediated inflammatory and/or thrombotic disorders, as the use of nanoparticles for targeted drug delivery enables differentiation between protective and pathogenic clotting. Targeting specific components of thrombosis, such as neutrophil extracellular traps (NETs), for example, can allow for antithrombotic or antiplatelet drugs to be delivered systemically with trafficking/accumulation at local sites, thus avoiding the negative systemic side effects observed with traditional antiplatelet therapies (Figure 2) (11). By using synthetic or engineered platelets as drug-delivery vehicles, sites of inflammation can be directly targeted with a biocompatible and biodegradable vehicle carrying a therapeutic payload. Importantly, these "platelets" can be designed to have a longer and more stable lifespan in the circulation than other common nanoparticle delivery systems such as polymers, liposomes, or inorganic nanoparticles (11,12). Moreover, platelets' large volume and surface area together with their flexible structure make them optimal for drug-loading, site-binding, and aggregation (13). Lastly, platelets' diversity of surface ligands and innate ability to localize and adhere to sites of inflammation allows for targeted, localized delivery with activatable drug release following activation of the engineered platelets (6).

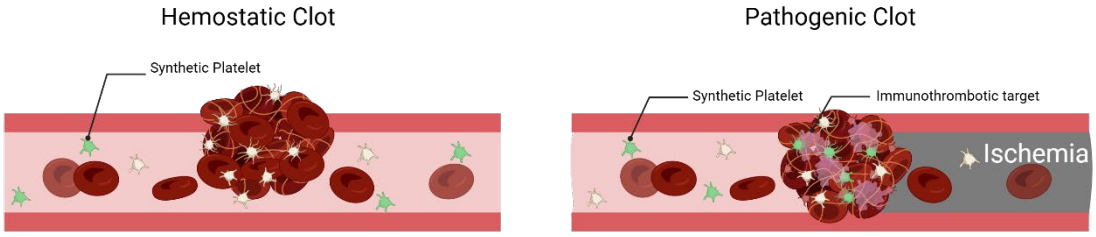


Figure 2: Synthetic platelet-based therapies can be engineered to have minimal interaction with protective hemostatic clots whereas selective inclusion of adhesion molecules or targeting antibodies can facilitate binding and accumulation on pathogenic immunothrombi. (Created using BioRender.com).

However, many challenges come with synthesizing platelet-like nanoparticles (PLNs) for potential use as a drug-delivery system. The two principal methods of creating PLNs have involved either modifying live donor platelets or designing platelet-mimicking nanoplatforms (11). A caveat of using live donor platelets is that they may require genetic modification or transfection with the drug and/or exogenous protein of interest before they can be used as a delivery vehicle (14). Moreover, although translationally active, they demonstrate low protein expression rates and are easily activated during modification (15). However, successful transfection of live donor platelets with minimal platelet activation using lipid nanoparticles has been previously shown (14). Despite the promising findings of this study, using live donor platelets as a therapeutic is limited by donor platelet availability, their short shelf life, bacterial contamination due to storage at room temperature with continuous mixing; optimal conditions for bacterial growth (16), and platelet activation during storage, impeding their realistic efficacy as a clinical therapeutic (6).

Various strategies for designing platelet-mimicking nanoplatforms have been tested, including cloaking nanoparticles with whole platelet membranes and designing nanoplatforms that express specific platelet surface proteins or peptides (Figure 3). For example, synthetic platelets have proven successful for treatment of uncontrolled bleeding in preliminary animal studies. Synthetic platelets in this study were composed of lipid nanoparticles expressing von-Willebrand factor, fibrinogen, and collagen binding sites, which are known to mediate the adhesion of activated platelets to the site of bleeding, mimicking the protective clotting mechanism of platelets in the hemostatic response (17,18). Importantly, these synthetic platelets did not affect resting host platelets but instead augmented the aggregation of activated platelets at the sites of bleeding and were shown to have a significantly longer shelf life (6-9 months) than live-donor platelets.

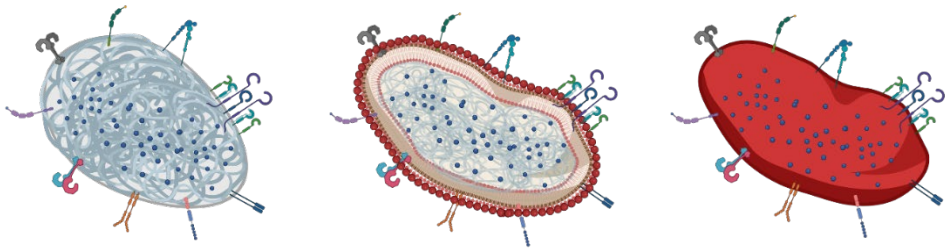


Figure 3: Representative examples of drug-loaded synthetic platelets developed by coating nanoparticles with target receptors (A), coating nanoparticles with whole-platelet membranes (B), and modifying live donor platelets (C).

To date, the use of synthetic platelets has been largely confined to mitigating hemorrhage complications; however, this early success opens the door for their use in a number of platelet-mediated inflammatory and immune conditions. In the context of cancer, platelets are both involved in early-stage tumour vascularization and interact directly with cancerous cells in a reciprocal crosstalk to enable tumour cell evasion mechanisms while simultaneously inducing platelet activation and aggregation as induce granule content release (19,20). Furthermore, platelets are naturally recruited to tumour sites, and they have the ability to infiltrate tumours. In many cases, an elevated platelet count, or the presence of platelets with an activated phenotype in cancer patients is associated with a poor disease prognosis. This central role of platelets in cancer makes these entities an ideal candidate to transport targeted immunotherapies, such as immune checkpoint inhibitors, monoclonal antibodies, or cytokines, to the site of tumour growth (21–23). Adaptation of synthetic platelets that carry potent immunotherapeutic payloads represents an opportunity to develop a "smart" medicine that following systemic administration, can seek out and accumulate within tumour sites. In this way we can harness what has been recognized as a poor prognostic indicator to develop a novel strategy to deliver medicines directly to the tumour. Several murine studies have already shown preliminary success in loading platelets with varied anti-tumour chemotherapeutic agents such as Doxorubicin and liposomes expressing TRAIL, as well as modified platelets to express anti-tumour receptors such as anti-CD44 and anti-PD-L1 (24). However, all platelets were sourced from living donors, which introduces several difficulties in potential use as a therapeutic as alluded to previously, such as the impact of storage time and conditions on bacterial contamination, bioavailability, platelet activation, and short circulation time, thus pointing to synthetic platelets as a more clinically relevant alternative therapeutic.

In the context of the inflammatory condition atherosclerosis (AS), which is the leading cause of death worldwide, current treatments include cholesterol-lowering drugs such as statins, blood pressure-lowering drugs such as ACE inhibitors and beta-blockers, and anti-clotting drugs including anticoagulants and antiplatelet therapies (25). Recently, groups have attempted strategies such as coating statins with hyaluronic acid (HA), which is known to bind well to CD44, a receptor implicated in the progression of AS (26). Although this strategy has shown preliminary success in animal models, CD44 is expressed on several cell types such as endothelial cells, smooth muscle, and immune cells, which once again evokes potential systemic side effects due to insufficient specificity (27). Using synthetic platelets coated with surface receptors specific for AS-associated vascular plaques, such as scavenger receptors, as a drug-delivery system for statins, ACE inhibitors, beta-blockers or others may allow for drug targeting to blood vessels containing atherosclerotic plaques or to acute ischemic thrombi, increasing the specificity, and thus efficacy of these therapies, while decreasing the risk of systemic thrombocytopenia and bleeding (28).

Deploying synthetic platelets as a therapeutic strategy would not be limited to AS and cancer; indeed, other chronic inflammatory conditions such as transplant rejection may be treated with a higher degree of specificity, thus decreasing lifelong systemic effects that plague transplant recipients. Due to the involvement of platelets in the vascularization of transplanted organs, as well as their role in the progression of transplant rejection through platelet-derived soluble CD40L, they are interesting candidates for a more targeted approach to anti-rejection therapeutics (29,30). In addition to sterile inflammatory diseases, this strategy may be effective in acute inflammation in the context of infectious diseases such as sepsis, malaria and influenza A virus (IAV). Pathogeneses associated with these infections frequently involve, and are intimately tied to, thrombosis. Secretion of pro-inflammatory cytokines during the initial phase of viral infection leads to an increase in the platelet-activating von Willebrand factor as well as the decrease of protein C, a key anticoagulant (31). Platelet activation in these infections leads to thrombosis which further drives the recruitment of additional inflammatory cells, creating a positive immunothrombotic feedback loop, significantly complicating treatment. Creating a synthetic platelet that is targeted to components of pathogenic clotting, such as NETs and activated neutrophils, would allow for antithrombotic and/or antiviral/antibacterial drug release specifically at sites of immunothrombosis, acting to limit/block this positive feedback loop, potentially ameliorating tissue pathogenesis, while simultaneously maintaining the body's hemostatic functions, ultimately improving patient outcomes. This strategy could also have clinical application as a preventative tool in acute situations. Given the staggering number of sepsis-related deaths in emergency medicine and long turnaround time for bacterial identification and antimicrobial testing, targeting the host response, specifically immunothrombotic clots, as opposed to trying to specifically address the pathogen, using synthetic platelets may offer an alternative, rapid and universal method to slow or prevent the progression of sepsis in this context.

Summary and Perspectives

Although early in their development, the involvement of platelets in a wide variety of inflammatory conditions combined with the preliminary success in synthesizing synthetic, 'robo-platelets', shows great promise as an alternative, targeted therapeutic strategy. Bypassing the need for live donors and the storage of platelets sourced this way may allow for potential 'off the shelf' therapies. The customizable nature of platelets as a vehicle for drug delivery through modification of their array of surface receptors and the flexibility for a diverse spectrum of therapeutic payloads, offers practically endless possibilities for clinical application of this strategy.

References

JLB Article Summary:Lost in translation: why language shouldn't silence good science

By Ramizah Mohd Sabri, PhD

Groundbreaking research should be judged on its scientific merit, yet for many non-native English-speaking scientists, language proficiency becomes an unfair barrier to publication. "Lost in Translation: Why Language Shouldn't Silence Good Science" by Lucia Leon-Valdez and Yanet Valdez Tejeira exposes the hidden biases in academic publishing that place undue emphasis on English fluency rather than the quality of research. The article highlights how researchers from non-English-speaking countries face extra hurdles—spending more time, money, and effort just to meet linguistic expectations, only to see their work rejected for reasons unrelated to its scientific rigor. This systemic issue not only stifles diversity in academia but also limits the global exchange of knowledge, preventing important discoveries from reaching the wider scientific community. The authors advocate for a shift toward equity in publishing, urging journals to prioritize scientific clarity over stylistic perfection and to provide better editorial support rather than outright rejection. Can the scientific community move beyond language as a gatekeeping tool and embrace a truly inclusive approach to knowledge sharing? Read the full article here.

The Engagement and Enrichment Committee: New Name, Renewed Commitment By Suzie Bohlson

We continue to be uplifted by our membership's commitment to welcoming and including all members in society activities. All of us on the Engagement and Enrichment Committee (EEC) have benefited from SLB opportunities to showcase our research, connect with colleagues and collaborators, and help build and support a broad, international, creative community focused on immunology and leukocyte biology. At the end of 2024 it became apparent to us that the name of our committee (previously called the diversity, equity, and inclusion committee), rather than the work we were doing, excluded some of our members. These members work at universities or industries where the acronym DEI and the words that make up the acronym (diversity, equity, inclusion) have taken on a meaning that no longer fully supports our mission.

As a result, our mission has not changed, but our name has changed. The Engagement and Enrichment Committee (EEC) aims to provide a welcoming and supportive environment for leukocyte biologists from all backgrounds to help everyone live up to their full potential. We want to dismantle barriers that impede access to leukocyte biology research and provide workshops, webinars, and articles that promote the professional development and career success of all SLB members. In addition, we continue to participate in the selection and recognition of our SLB annual meeting speakers to identify and celebrate the best that the field of leukocyte biology has to offer.

SLB adapts and evolves, as does this committee. This is not the first time our name has changed. Prior to being called the DEI committee, we were "The Women and Diversity Committee." Although women still face significant professional challenges, the women and diversity committee is too narrow a name to fully engage and enrich all of our membership. By referring to "women," we unintentionally excluded some members of our society who did not identify as women but were generally interested in promoting initiatives that help women, and all members, thrive in their professions. We've reached a similar point with the name DEI, and we hope that all SLB members crave engagement and enrichment in our society and the larger scientific community.

Our goal is to embrace change and in so doing to continue moving forward with our important initiatives and also develop new practices that better reflect the interests and needs of all SLB members. SLB will benefit from an engaged, fair, and healthy society when everyone fully benefits from the best education, training, and ideas that leukocyte biology has to offer.

OUP signs landmark agreement with California Universities

SLB and JLB and proud and excited to spread the news that our publisher, Oxford University Press has signed a landmark read and publish agreement with the California University system. Learn more below and submit your manuscript to JLB today!

See the official press release on the CA agreement: California Universities and Oxford University Press Sign Landmark Open Access Agreement - Office of Scholarly Communication.

See the R&P agreement page on the OUP website along with the author workflow guide: https://academic.oup.com/pages/open-research/read-and-publish-agreements/university-of-california-uc-california-state-university-csu-and-statewide-california-electronic-library-consortium-scelc-affiliated-institutions.

2025 Legacy Awardee, Elizabeth J. Kovacs, Ph.D.

A Career Sparked by Curiosity

An Interview by Julia Bohannon

Elizabeth J. Kovacs, Ph.D.

Director of Burn Research, Director of the Alcohol Research Program, Professor, and Vice Chair of Research, Department of Surgery, University of Colorado Denver/Anschutz Medical Campus

I had the distinct pleasure of sitting down with Dr. Liz Kovacs to discuss her incredible career. I have known and admired Liz since my early days in graduate school, first meeting her at my first SLB conference more than 15 years ago. Being in a similar research field of innate immunity in burn trauma, I have long admired her work, and she has been truly inspirational as an incredible role model for women and trainees in science. Her career, dedication to mentorship, and scientific contributions continue to shape the field in profound ways.

Q: What led you to research burn and alcohol immunology?

A: It's a funny story—When I was a faculty member at Loyola University Chicago, I was in the ladies' room chatting with a research nurse, Vicky McGill, who was writing a paper on alcohol and burn injury. Instead of making small talk about the Cubs, I asked what kinds of patients were in the Burn ICU. She explained that many young adults ended up in the burn unit after alcohol-related incidents and their prognosis was much worse than comparably injured non-drinkers. That conversation led me to explore alcohol and burn injury. My mentor, Dr. Richard Gamelli, gave me a small amount of funding—$6,000—to develop a mouse model. That small grant turned into three decades of NIH funding. It was a moment of curiosity that changed the course of my career. Moreover, there are two important life lesson from this experience 1) to be open to new research ideas and 2) think about working on something that is of interest to the boss. The latter might encourage them to toss some $$ in your direction.

Q: Where were you in your career when this shift happened?

A: At the time, I was an associate professor studying scar tissue formation and innate immunity. I wasn't originally working on burns, but after that first conversation, I kept asking questions. A couple of years later, in the same ladies' room, Vicky mentioned how older burn patients had worse outcomes. That led me to aging and burn injury research, which has now been funded by NIH for over 20 years. These shifts in research focus often come from simply paying attention to patterns in patient populations and being open to new challenges.

Q: What has been your most exciting research discovery?

A: When I was a postdoc at NIH, working on my favorite cell, the macrophage, a colleague suggested I use these cells as a control in a T-cell activation study. I added IL-2, expecting nothing—but they responded. That moment changed my understanding of immune cell interactions. Later, having taught histology to medical students for many years, I felt comfortable connect gut-liver-lung interactions in burn injury, which was groundbreaking at the time. Understanding how different organ systems communicate during trauma and recovery has been one of the most exciting aspects of my work.

Q: What are the biggest challenges in the field?

A: Team science is crucial. Burn research requires collaboration across disciplines—clinicians, PhD scientists, and engineers. If we only studied macrophages in cell culture, we wouldn't get anywhere. Another challenge is ensuring scientists, particularly women and minorities, get proper credit for their work. I've been fortunate to have mentors who recognized my contributions, but I know that's not always the case for others. Advocating for fair recognition and strong mentorship is essential.

Q: What's next for your research?

A: We're expanding into neuroscience. Nearly all older patients experience delirium, PTSD, or cognitive issues after major trauma. My background in neurobiology from my undergraduate days at Reed College has come full circle as we explore how remote burns affect the brain. It's an exciting new direction that ties together immunology, trauma, and aging in ways we haven't fully explored before. It has also allowed me to work with a broader range of collaborators on campus.

Q: Tell us about your lab.

A: We currently have two technicians, two postdocs, a medical scientist training program (MSTP) graduate student, a research associate professor, and a surgeon-scientist mentee. Last summer, we had a high school student and an undergraduate. Next summer, a surgical resident will join the lab. We're looking to bring in another postdoc and technician soon. It is great to have a broad range of backgrounds and experience in the lab. We all learn from each other. My lab has always been a place where we foster curiosity and independent thinking, and I take great pride in helping trainees find their own research paths.

Q: What's it like mentoring physician-scientists as a PhD?

A: It's been great. One of my surgeon-scientist mentees moved to Colorado to work with me. He secured a K award early on,

which doesn't always happen with clinical colleagues, and he now has an R grant. Moving institutions meant reestablishing myself and rebuilding collaborations. I am still having "science playdates" with people across the campus. It is also very refreshing to work with the cadre of basic and clinician-scientists who have sought me out for mentorship and collaboration.

Mentoring has been one of the most rewarding aspects of my career. I take pride in helping trainees find their own paths and develop the skills they need to succeed. Some of my former trainees have gone on to become independent investigators, leading their own NIH-funded labs, while others have made significant contributions in clinical research and industry. Seeing them grow into accomplished scientists is a true highlight. I have always believed that good mentorship is about more than just guiding a project—it's about developing people into confident, capable leaders in their fields.

Q: How has SLB impacted your career?

A: I've been involved with SLB since the late 1980s. Being part of this society has given me access to brilliant scientists, mentors, and collaborators. Through SLB, I learned how to write grants, review papers, and engage in scientific leadership. I've also met trainees who later joined my lab. The opportunities SLB has provided me have been invaluable in shaping my career, and I am incredibly grateful for the friendships and professional relationships I have developed through the society.

Q: What does winning the Legacy Award mean to you?

A: It's incredibly meaningful. I've watched past recipients make major contributions to the field, and to be recognized among them is a great honor. SLB has been my professional home, and this award is a wonderful culmination of my career's work. It reflects not only my efforts but also the support and collaborations that have made my research possible.

Q: What's your best advice for young scientists?

A: Stay open to new ideas and collaborations. My research evolved because I asked questions outside my comfort zone. Also, diversify your funding sources—while most of my funding is from NIH, I've also received foundation grants and VA support. Early on, I applied for grants from organizations with Midwest ties and female names in their titles. It worked!

Another tip: Look into administrative supplements for NIH grants. They can provide extra funding to explore new areas without writing an entirely new grant. Always be on the lookout for creative ways to support and expand your research.

Q: What do you enjoy outside of research?

A: I love skiing—it's my escape. I used to play soccer, but after eight knee surgeries, I had to stop. Now, I hike a lot. My friend and I completed a 142-mile trail through Denver, and we're working on a 170-mile loop connecting various trails. Living in Colorado, with its blue skies and open spaces, has been great for my well-being. The outdoors provides a perfect counterbalance to the demands of research, and I make sure to take time to appreciate it.

One of my greatest joys outside of the lab is keeping in touch with my former trainees. Over the years, my lab has become like a family, and I've celebrated countless milestones with them. Many of my trainees have started families of their own (79 babies in all so far!), and I've had the privilege of knitting blankets for their babies and staying connected as they grow in their careers and personal lives. We've remained close through conferences, reunions, shared adventures (like ski trips!), and ongoing collaborations. Watching them succeed—both professionally and personally—has been one of the most rewarding aspects of my career. It's a testament to the deep, lasting relationships built through mentorship and shared passion for science.

Q: Who else would you like to acknowledge?

A: First and foremost, I want to express my deep appreciation for Jen Holland, the Executive Director of SLB. Her dedication to the society and its members has strengthened our community in countless ways. Her efforts ensure that SLB continues to be a place where scientists can thrive, collaborate, and push the boundaries of immunology research. So many people have supported me along the way. My mentors: As a postdoc, Joost (Joe) Oppenheim, who introduced me to SLB (and was a previous award winner!). As a faculty member, Richard Gamelli, helped shape my career, encouraged me to take chances in research, and gave me leadership opportunities. My colleagues and collaborators have been invaluable, and I deeply appreciate the friendships I've built through SLB and beyond. Most importantly, I want to acknowledge my trainees—past and present—who continue to inspire me. Their successes are my greatest achievements, and I feel privileged to have played a role in their scientific journeys.

Last, but definitely not least, I need to thank my amazing daughter, Cathy, who kept me grounded and, back in the day, hugged me as tightly when I had a paper rejected as she did when I had a grant application funded.

Dr. Lee-Ann Allen: A Career Enriched by Scientific Community and Leadership

By Amali E. Samarasinghe, Membership Committee Chair

Dr. Lee-Ann Allen's career has been significantly shaped by her active membership and leadership within the Society for Leukocyte Biology (SLB). Initially, her journey into the field of macrophage and neutrophil biology began during her postdoctoral research, which ultimately led her to a faculty position at the University of Iowa. Dr. Allen worked alongside Dr. William Nauseef for over two decades, and his guidance was instrumental in shaping her career. Though he has since retired, she fondly recalls his influence, which continues to resonate in her approach to science and mentorship and academic leadership. It was Bill who encouraged her to attend her first SLB conference in 2003 (attending every year thereafter except one!) where she immediately embraced the society's vibrant and collegial network of researchers.

Her involvement with SLB proved invaluable for both her scientific development and professional growth. From her early days, Dr. Allen engaged with senior scientists, peers, and emerging researchers, forming key collaborations and friendships within the leukocyte biology community. Dr. Allen's journey within SLB also introduced her to opportunities in scientific leadership. Her first leadership role came when she was nominated to the society's nominating committee, an experience that broadened her professional horizons. Subsequently, Dr. Allen served two terms as treasurer, before being elected as president-elect, president, and past president of SLB. Her leadership helped guide SLB through pivotal changes, including the transition of the *Journal of Leukocyte Biology* from self-publishing to its productive partnership with Wiley, a move that provided significant resources for the society's future. Currently, Lee-Ann proudly represents SLB on the board of the Federation of American Societies for Experimental Biology (FASEB). Over the years, through her contributions, Dr. Allen has fostered a collaborative environment where society members could participate and grow alongside her.

Reflecting on her achievements, Dr. Allen considers her success as a mentor to be at the heart of her career. She feels fortunate to have begun her independent career in 1996; a time when funding opportunities were robust, making securing grants less daunting. This fortunate timing, combined with her dedication to research and her strong support network, allowed her to build a thriving career. In addition to her research achievements, Dr. Allen emphasizes the importance of passion in work. According to her, the thrill of discovery and the motivation to explore the unknown have sustained her through the inevitable challenges of a scientific career – whether dealing with financial pressures, experimental setbacks, or moments of uncertainty. Her advice to aspiring scientists is clear: "You have to be committed to the work and driven by curiosity. Without that, it might be worth considering a different path within science."

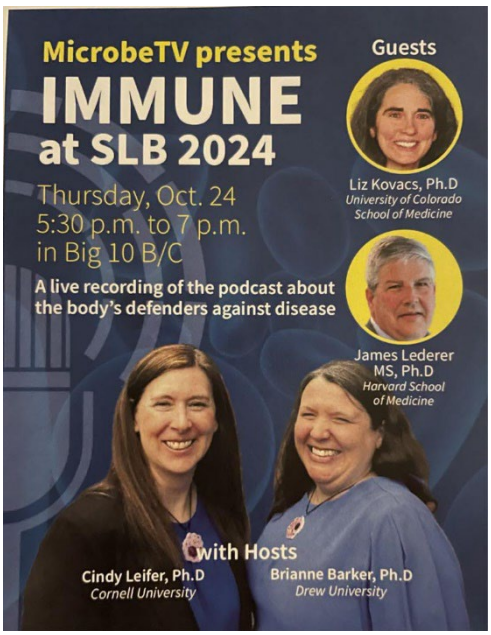
In 2020, Dr. Allen assumed the role of Department Chair at the University of Missouri, a position that brought unforeseen challenges due to the COVID-19 pandemic. Balancing leadership responsibilities with ongoing research commitments presented a unique set of obstacles. She reflects on the learning opportunities that the Chair position offered, including navigating university leadership, as well as managing finances and resource allocation to advocate for the Department, which includes 27 faculty members. Dr. Allen notes that the leadership experience she gained through her work with the SLB provided a solid foundation for her development as a leader.

One of the most significant personal influences in Dr. Allen's life is her love of reading. She recently read *The Premonition* by Michael Lewis, which explores the public health response to COVID-19. Dr. Allen, a lifelong reader, recalls her father taking her to the public library every other Saturday, instilling a love of books early on. She believes that the decline of reading full books in favor of summaries could hinder critical thinking, especially in young scientists.

Outside of science, Dr. Allen enjoys cooking, with lasagna being her go-to comfort food, particularly a homemade spinach and sausage version. Cooking offers her a break from her demanding career, and food serves as a reminder to take care of yourself. Dr. Allen's favorite travel destination is Italy. She once took a Sierra Club hiking trip that combined outdoor exploration with food, where she visited family-run olive oil farms and local restaurants. The trip left a lasting impression, and she and her husband are planning a return to Italy, to visit Verona for a second time and surrounding towns like Modena and Bergamo.

Ultimately, Lee-Ann describes SLB as a "family"; a smaller, more intimate scientific society where lasting relationships and professional development go hand in hand. Her involvement with SLB has been a cornerstone of her career, offering both personal fulfillment and significant contributions to the field of leukocyte biology. Dr. Allen's journey, from research breakthroughs to personal passions, shows that success is about more than just professional achievements, it's about passion, mentorship, and maintaining a balanced life. Whether advancing scientific knowledge or enjoying a good book and a home cooked meal, Dr. Allen exemplifies how to live a fulfilling career.

Immune Podcast Review By Cindy Leifer



In addition to the amazing science presented at SLB2024, there was a special session where Cindy Leifer and Brianne Barker hosted a live recording of the YouTube Show and Podcast "Immune". Brianne, an associate professor of Biology at Drew University, and Cindy have recorded Immune for almost 7 years with their other co-hosts Vincent Racaniello and Stephanie Langel. Immune is one of several shows that are part of Microbe.tv, a non-profit organization that creates science shows for everyone.

New episodes of Immune are released monthly and typically highlight recent immunology research. The co-hosts introduce immunology topics and then review one to two papers. They go through the data and discuss the conclusions and caveats. The format is similar to a regular journal club. However, Immune sometimes has guest immunologists who join and talk about their recent publications. Immune has also recorded several special episodes at national immunology conferences.

At SLB 2024, there was a live recording featuring two SLB members, Jim Lederer and Liz Kovacs. The audience included a broad representation of those attending the conference. During the show there were lots of laughs, fun facts, and stories of how both Jim and Liz got interested in science. Liz began research in high school and says, "One of my reasons for becoming a scientist is because I competed with my brother just a little bit and he was good at everything… but science." Jim was inspired by his aunt who was a science teacher and took him on field collection trips where he paddled around in pond water and learned about science. A common theme was how important the experiences they had when they were young in shaping their love for science. They also talked about their labs and the research they have done over time. Liz talked about what SLB means to her and why she comes to the annual meeting, "It is a great idea to come to (the SLB) meeting from the time you are young to when you are older in part because you see the progression of science and the progression of life…When I was a trainee, I was enamored with the big shots and was amazed that I could actually sit down and talk to them at this (SLB) meeting."

Behind the scenes at the conference, Cindy and Brianne were also doing interviews with several different scientists at the meeting. These shorter episodes are called "Immune boosters" and are generally less scientific and more focused on getting to know the scientists. These more accessible episodes introduce more of the general population to scientists and showcase their passion for research in improving human health. The SLB2024 boosters showcased Amanda Brown, Amy Hise, Darren Lee, Holger Heine, and Justin Wilson. These episodes are shorter and are typically released about one to two times per month.

With the recent attacks on, and the erosion of public trust in, science, these types of science communications are both a breath of fresh air and a positive force to rebuild trust. You can find episodes of Immune and other shows like "This week in virology" and "This week in microbiology" at microbe.tv. If you have comments or questions or are interested in being a guest on the show, send an email to us at immune@microbe.tv.

ICYMI

SLB's on-demand library of scientific and professional development videos continues to grow! Available to society members anytime, check out the resources available anytime. The latest additions include talks on "Inflammation-on-a-Chip: Redefining How We Study Immune Responses" and "Investigating vascular ageing and its impact on immune cell function: When neutrophils get mad!".

Watch

FASEB CORNER

Collaborative Advocacy for Biomedical Research – Amid ongoing disruptions to research related to actions of the new Administration, FASEB is offering expanded advocacy tools and training to help scientists make their voices heard on Capitol Hill:

- FASEB hosted a virtual town hall meeting to provide an overview of the 119th Congress and share updates on the status of the presidential transition.
- FASEB provided Advocacy 101 training, with information on how to be an effective advocate and tips for engaging with members of Congress and their staff.
- A second online training offered instructions on submitting fiscal year (FY) 2026 Appropriations Programmatic Requests. This spring, members of Congress will have the opportunity to identify their priorities for how federal funding should be allocated to the National Institutes of Health (NIH), National Science Foundation (NSF), and other agencies. Since most House and Senate offices have a process to solicit input from their constituents to help inform their views on funding, FASEB encourages scientists to reach out to their elected officials to ask them to submit FY 2026 programmatic requests to the appropriations committees.
- FASEB sent a letter to House and Senate leaders highlighting the impact of recent administration actions that have been detrimental to biomedical research. The letter urged Congress to engage in a bipartisan effort to ensure NIH can disburse already appropriated funds and reject efforts to implement a 15 percent cap on Facilities and Administration (F&A) costs.
- FASEB issued statements on the pause in grant funds and the administrative costs cap.
- FASEB issued an e-action alert allowing the research community to contact their Senators and Representatives to express concern about the F&A costs proposal.
- A Threats to Federal Research Funding Resource Center that includes a curated list of resources related to the administration's actions is available on the FASEB website. The Resource Center includes links to FASEB and FASEB member society statements, as well as pending legal cases and decisions.

DEAI Updates – Early-career researchers (ECRs) were encouraged to apply to the newly launched Fellows for the Future program. This program is designed for researchers from historically excluded groups who want to be more actively involved in their professional society. It provides mentorship, leadership training, and sponsored engagement in scientific societies' professional development opportunities. It is funded by NSF's Leading Culture Change through Professional Societies of Biology (BIO-LEAPS) program. Selected fellows will be announced in spring 2025.

Providing Advocacy Training for Researchers – To underscore FASEB's commitment to advance science policy and advocacy, nine individuals from FASEB societies were selected for the 2024-2025 Howard Garrison Advocacy (HGA) Fellowship. The HGA Fellowship is a 10-month cohort program that provides instruction in advocacy, science policy, science communications, leadership development, and career exploration outside academia. HGA Fellows attended the FASEB Science Policy Symposium in October 2024 and will also participate in the Federation's Capitol Hill Day on March 19, 2025.

Supporting Researchers Who Are Caregivers – Last fall, 10 researchers at several FASEB societies each received $5,000 through the FASEB CARES (Career Advancement and Research Excellence Support) awards. These awards acknowledge that family caregiving can be challenging to career advancement and are meant to help alleviate financial burdens associated with caregiving, enabling researchers to continue their scientific training.

Empowering ECRs – To better represent the unique insights and views of younger scientists at the highest levels of Federation leadership, voting positions on FASEB's Board of Directors and Science Policy Committee (SPC) are reserved for early-career scientists. One Board and one SPC early-career representative will be selected to serve a two-year term, beginning July 1, 2025. Applications are due by March 24. Successful applicants will be notified in early June. Additional details about the responsibilities and time commitment for the FASEB Board and SPC position are available on the application site.

The Hero's Journey Series Continues

SLB's The Hero's Journey Series is an interview project led by Jacqueline M. Howells, PhD, in collaboration with the Society of Leukocyte Biology (SLB). The series features interviews with SLB members across various career stages and fields, aiming to create an interconnected network by highlighting the diverse backgrounds and motivations of individuals within the field of leukocyte biology. The idea for this project stemmed from an inquiry from SLB, asking for webinar topics that would benefit the community. Howells' response, which proposed a deeper understanding of the scientists behind leukocyte biology, unexpectedly sparked widespread interest. The series, with it's first installation in the 2024 Vol 3 issue of iSLB, continues now with 4 more insightful interviews.

Dr. Blake Caldwell

Read about Blake's Journey

Dr. Allison Owen

Read about Allison's Journey

Dr. Xuewei Zhu

Read about Xuewei's Journey

Dr. David L.Williams

Read about David's Journey

Behind the Science: Interview with JLB Author Rupesh Srivastava

Read the full article in JLB...

by Subhash Arya

Translational Immunology, Osteoimmunology & Immunology Lab (TIOIL)
An ICMR Collaborating Centre of Excellence on Bone Health

Q: What sparked your interest in science, and how did your journey in research begin?

A: During my doctoral research work form NCCS, Pune I got a glimpse of the very exciting and thrilling field of Immunology. This led me to further continue my research work in the field of

Gut-resident Tregs (GTregs) play a pivotal role in maintaining bone health under post-

Bone and Immunology at Columbia University Medical Centre, NY, USA and Roswell Park Cancer Institute (RPCI), New York, USA. After coming back to India at All India Institute of Medical Sciences (AIIMS), New Delhi, I am actively involved in deciphering this new field which is still in its very naive state. My research specifically focuses on the cellular and molecular interactions between the Immune and Bone systems i.e "Osteoimmunology", a very recent branch of modern biology which specifically deals with the interplay between the immune cells (CD_4, CD8 T cells, B cells, DCs, Macrophages, ILCs etc.) and bone cells (Osteoclast, Osteoblast & Osteocytes). During normal physiology both systems are at homeostasis but during an imbalance due to various stimuli (infection, autoimmunity, environment, ageing, hormones etc.), it leads to various inflammatory conditions such as Osteoarthritis, Rheumatoid Arthritis & Osteoporosis (viz. post-menopausal osteoporosis). Thus, a molecular understanding of these interactions is at the

heart of my research which would ultimately lead to discovery of novel therapeutics for various inflammatory bone conditions.

Q: What led you to choose your current research topic, and what excites you most about it?

A: In the past 12 years of my research carrier, I have extensively explored the role of various immune cells, including Tregs, Bregs, Th17, and Th9, in the pathogenesis of osteoporosis. I have coined the term **Immunoporosis,** which specifically deals with the involvement of the immune system in the pathophysiology of osteoporosis. Approximately 80% of the immune system resides in the intestine, and several recent studies have highlighted the impact of gut permeability and dysbiosis on osteoporosis. These findings led me to hypothesize that the gut-immune system could play a crucial role in osteoporosis. Given the pivotal role of Tregs in preventing osteoporosis, I sought to investigate the gut-resident Tregs as potential therapeutic targets. Interestingly, our results demonstrate that GTregs have a crucial role in regulating bone health, making it exciting to consider that the gut immune system could be a key player in the treatment of osteoporosis.

Q: Can you summarize the key findings of your paper in simple terms, as if explaining them to a non-biologist?

A: Our results indicate that gut-resident Tregs enhance the activity of osteoblasts, which are responsible for bone formation while suppressing the differentiation of osteoclasts, which resorb bone. This balance helps prevent bone loss and supports overall bone health.

Q: What was the most exciting or memorable moment during this research journey?

A: One of the most exciting and memorable moments in my research journey was when we uncovered a critical link between the gut and immune system via the GTregs. Our findings provided compelling evidence that gut-resident GTregs play a pivotal role in protecting against osteoporosis. This discovery not only reinforced the concept of the gut-bone immune axis but also opened novel avenues for exploring microbiome-targeted therapies for bone loss.

Q: What was the biggest challenge you faced while working on this project, and how did you overcome it?

A: Initially, isolating various immune cells from the intestines was challenging. However, through extensive literature searches, and discussions with my collaborators and researchers in my group, the protocol was refined and modified, ultimately enabling the successful isolation of immune cells from the intestine.

Q: What advice would you give to junior or incoming Ph.D. students aspiring to build a career in science, especially in your field?

A: To junior or incoming Ph.D. students aspiring to build a career in science, my advice would be that hard work and perseverance matter more than just knowledge. Diligence and persistence will take you further than mere intelligence. Additionally, the ability to effectively present your research—whether at conferences, in publications, or through informal discussions—is crucial. Strong writing and presentation skills can set you apart in the scientific community. Perform your work with sincerity and consistency. Always be open to guidance from your mentor and seniors, as their experience can provide invaluable insights.

Q: Outside of science, what is something interesting about you that our audience might enjoy knowing?

A: Beyond science, I have a deep passion for photography and cooking, allowing me to express creativity in different ways. I also love traveling and exploring new places, immersing myself in diverse cultures, landscapes, and experiences that broaden my perspective on the world.

Q: What are your next steps—whether in research, career goals, or new scientific pursuits?

A: My career goal is to take my research in Immunoporosis to the next level by translating my findings into therapeutic applications. After establishing the role of various immune cells in the pathophysiology of osteoporosis, my next focus is to specifically target/modulate these cells for their potential therapeutic applications in managing and treating the burden of bone loss in various pathologies.

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