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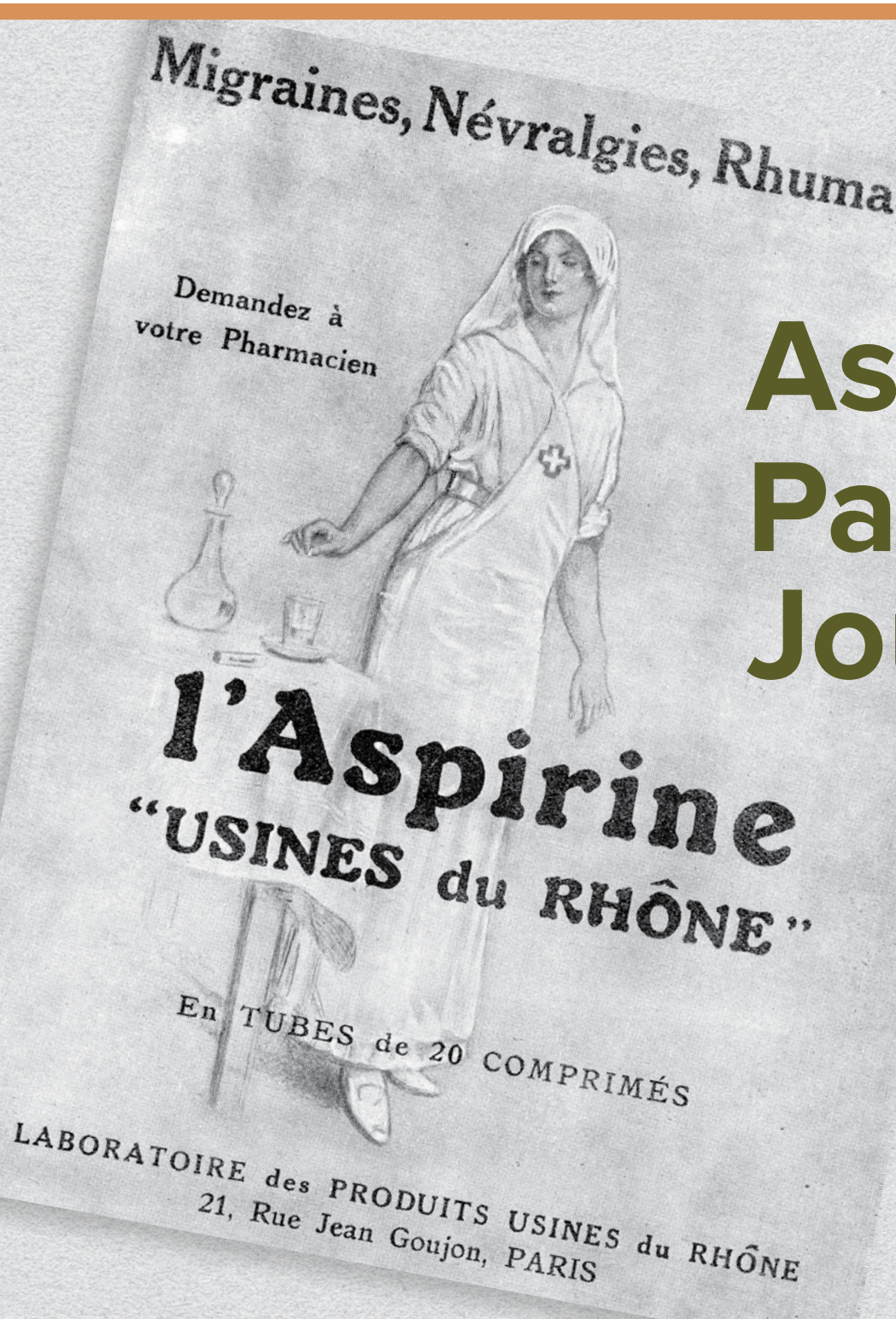

Aspirin's Painless Journey

INSIDE

ASPET
Transforming Discoveries into Therapies

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Contents

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Message from The President

Dear Fellow ASPET Members,

It has been quite a year, hasn't it? I am honored to be the 90th president of ASPET, especially during this time of world renewal. Despite the close down last year, ASPET has done very well. Several of the Council members who helped steady the Society are leaving the Council and we owe them special thanks for their exemplary service: Wayne Backes as Past-President, Jin Zhang as Past Secretary-Treasurer, and Kathryn Cunningham as Councilor. We now welcome new Council members: John Traynor, Councilor; Kathryn Cunningham as Secretary/Treasurer-elect, and Mike Jarvis as President-elect. I look forward to working with our new members to keep ASPET moving forward.

Despite the COVID-mandated shut-down, ASPET had a productive year. I credit our out-going president, Charles France, for propelling ASPET toward the future during a year that could have seemed inert. Despite the 2021 meeting being virtual, it was well-attended and easy to navigate. I was especially grateful for the way the posters were organized; the mechanism gave attendees a nice chance to chat, either virtual or live, with the presenters. It was also helpful to be able to go back and visit sessions or posters that one might have missed. There are always silver linings. ASPET also further refined its skills in virtual programming; there were over 20 virtual sessions given through our Focus on Pharmacology series, with over 1,200 registrants from 30 different countries. These webinars are an excellent way to enhance Society impact. Don't forget that the excellent Focus in Pharmacology series is available on ASPET*Connect* (https://bit.ly/3lOazb5). Next year, I am hoping there are more, with podcasts included. Pharmacology is an amazingly interesting and useful discipline; we want everyone to know it!

There are distinct challenges and projects that are facing us in the upcoming year on which Council and Staff will be working hard.

ASPET meeting in 2023. ASPET is having its first stand-alone meeting in many years in 2023. The exciting part of that sentence is that we get to create a meeting with components most desired by the members. Many ASPET members were already contacted by our meeting strategy consultant, Storycraft Lab, to give input about the meeting. The general consensus is that members want more content in a shorter amount of time. That may stretch physical limitations, but we will be sensitive to these issues. However, we're hoping for even more member participation. Please contact ASPET with meeting ideas and components that are important for you (meetings@aspet.org). This is our chance to do it 'our way'.

DEI task force. In the past year a task force was formed to ensure diversity, equity, and inclusion within all aspects of the Society. I am especially excited about this initiative because, as you may remember from my statement on the campaign trail, DEI is an important issue to me. While the Society has always been mindful of DEI, the task force will make important recommendations to guarantee that we consider and act on these issues in all decisions and in all aspects of the Society.

I am truly hoping that the focus on diversity will result in increased membership for the Society. I am devoted to the notion of ASPET being a home to pharmacologists that reaches beyond research universities and industry. Because pharmacology is such a special discipline, pharmacologists are readily employed in a wide variety of careers. If anyone has ideas along these lines, I am more than pleased to hear them. Email me at any time (pgnegy@umich.edu).

Bylaws revision. Although there have been piecemeal changes to the bylaws over the years, there has not been a serious overhaul of the bylaws in quite a long time. Some of the language goes back to the establishment of the bylaws 90 years ago. Times have changed and the governance and operations of the Society must change with them. A task force chaired by Mary-Ann Bjornsti, past Secretary-Treasurer, has been established to review and revise the bylaws and will be working hard during this year.

Strategic plan. Our present strategic plan is 5 years old. In order to keep up with changes in the world, we must change with it. Council will start working on a new 5-year strategic plan this year. There were notable successes from our last strategic plan. One that I would mention here is the Partnership Committee, chaired by former ASPET president Eddie Morgan. Through the work of this committee, ASPET is extending its hand to pharmacologists across the world. New relationships with societies and individual pharmacologists in South America, Central America, Mexico, and Africa are being established.

Journals. The Board of Publications Trustees is now the Publications Committee. It is headed by the dedicated and steady hand of Emily Scott. This committee is tasked with navigating the journals through the changing landscape in publishing. We said goodbye to Rich Dodenhoff who had expertly served as Director of Journals for many years. We hope you enjoy your retirement, Rich. We welcome Maria Pasho as our new Director of Publications. She brings excellent journal experience from ASBMB.

EB 2022. In all the excitement of having our own meeting in 2023, please don't forget EB 2022. Although I pointed out a few advantages to the virtual format, nothing can compare to meeting our fellow pharmacologists face-to-face. I look forward to meeting all of you - old friends, students, and new pharmacologists alike. That is a great part of the joy of these meetings. I urge you all to come, submit your abstracts this fall, and have a wonderful time learning exciting new science. Best of all, I get to see you at the ASPET Annual Business Meeting in person!

To give credit where it's due, none of these important initiatives could be completed without the aid of a highly competent and hard-working staff. We owe them a large round of applause and I am very grateful for all they do. As the new president, I owe a great debt to my past-president tutors, Wayne Backes and Charles France. Both have worked tirelessly to make solid improvements to ASPET during this past year. In doing so, they have taught me a great deal.

Have a great year. I hope to see you in Philadelphia from April 2-5 in 2022.

Margaret E. Gnegy, PhD
ASPET President

2021 ASPET Fellows

The ASPET Fellows Program was initiated in 2019 to honor our most distinguished members. Selection as a fellow of the American Society for Pharmacology and Experimental Therapeutics (FASPET) is an honor bestowed on ASPET members who have demonstrated excellence via their overall contributions to pharmacology and the Society. Learn more about the FASPET program at www.aspet.org/faspet.

The ASPET Council is pleased to announce the 2021 class of fellows:

Charles Chavkin, PhD

P. Jeffrey Conn, PhD

Michael A. Frohman, MD, PhD

Beverley Greenwood-Van Meerveld, PhD

T. Kendall Harden, PhD

Kenneth A. Jacobson, PhD

Kathryn E. Meier, PhD

Edward T. (Eddie) Morgan, PhD

Robert R. Ruffolo, PhD

John D. Schuetz, PhD

Phil Skolnick, PhD, DSc (hon)

Alan V. Smrcka, PhD

Kenneth D. Tew, PhD, DSc

Kenneth E. Thummel, PhD

Rita J. Valentino, PhD

Jin Zhang, PhD

To read more about the ASPET fellows and their accomplishments, please visit:
https://bit.ly/3jPwLQE

We would like to thank the Fellows Review Committee for their hard work.

John Lazo, Chair
James Barrett
Joan Heller Brown
Margarita Dubocovich
Paul Hollenberg
Charles Rutledge
Lynn Wecker
Pancras Wong

2022 Annual Meeting

The ASPET Annual Meeting is *the* place to discover and to present the highest quality, innovative science in pharmacology and experimental therapeutics.

ASPET welcomes all scientists passionate about pharmacology to gather **April 2-5, 2022** in **Philadelphia** as ASPET intersects with other experimental biologists in physiology, biochemistry, molecular biology, pathology, and anatomy at the last Experimental Biology conference (EB).

Be inspired by the latest scientific advances in diverse areas, share your research and get feedback on your work, create connections with your scientific collaborators and discover new ones.

Share Your Research

Abstract submissions are due by November 30, 2021
Submit your abstract online at www.aspet.org/eb2022/abstracts

We encourage the submission of abstracts to ASPET topic categories in all areas of pharmacology and experimental therapeutics detailing your latest work. The benefits received by accepted abstracts include:

- Receiving feedback on your work
- Being recognized for your scientific advances
- Sparking conversations with potential research collaborators and employers
- Opportunities to compete for travel and poster awards (students and postdocs)

Your research will be disseminated through multiple formats, including: a poster presentation in Philadelphia, a PDF upload of your poster to the online EB program, a 5-minute audio recording explaining your research, and publication of your abstract in the online EB program and in *The FASEB Journal*.

You will be able to engage in Q&A directly with visitors to your poster presentation in the exhibit hall plus receive written Q&A through the EB online program.

ASPET will help bring other scientists to you to discuss your work. Top scoring abstracts are designated as Program Committee Blue Ribbon Picks, are featured at the EB-wide welcome reception, and are selected to give oral presentations at the popular ASPET Datablitz, in symposia, in a new ASPET hot topics symposium, and in division platform showcases.

Abstract submissions close on Tuesday, November 30, 2021. Submit your abstract at www.aspet.org/eb2022/abstracts

ASPET is specifically seeking abstracts in the following research areas:

- Cancer Pharmacology
- Cardiovascular Pharmacology
- Cellular and Molecular Pharmacology
- Central Nervous System Pharmacology
- Behavioral Pharmacology
- Drug Discovery and Development
- Drug Metabolism and Disposition
- Pharmacogenomics and Translational Pharmacology
- Pharmacology Education
- Toxicology
- COVID-19
- Perspectives in Global Health
- Pharmacology – All Other

Didn't find your specialty listed? Search all pharmacology-related topics at **www.aspet.org/eb2022/abstracts** or search EB topic categories at **www.experimentalbiology.org**.

EB Experimental Biology 2022 PHILADELPHIA, PA APRIL 2–5

ABSTRACTS

Submit today at www.aspet.org/eb2022/abstracts

Top 5 Reasons to Submit an Abstract for the ASPET Annual Meeting at EB 2022

1. Spark conversations with potential collaborators.
2. Be recognized for your scientific advances.
3. Receive feedback on your work.
4. Have opportunities to win awards.
5. Take part in the last EB.

Preliminary Program

Plan your travel around the ASPET program schedule:

Saturday, April 2, 2022

10:00 am – 10:45 am	Opening award lecture
11:00 am – 12:30 pm	Concurrent symposia
12:30 pm – 1:30 pm	Break for lunch with a colleague
1:30 pm – 3:00 pm	Concurrent symposia
3:15 pm – 4:00 pm	Keynote lecture
4:30 pm – 6:00 pm	ASPET Business Meeting and Awards Presentation
6:00 pm – 7:00 pm	Tang Foundation Prize lecture
7:00 pm – 8:30 pm	EB welcome reception

Sunday, April 3, 2022

8:00 am – 9:30 am	Concurrent symposia
10:00 am – 12:00 pm	Poster presentations including the ASPET Datablitz
12:00 pm – 1:00 pm	Break for lunch with a colleague
1:00 pm – 1:45 pm	Award lecture
2:00 pm – 3:30 pm	Concurrent symposia
4:00 pm – 6:30 pm	ASPET Student-Postdoc Poster Competition
8:30 pm – 11:00 pm	Student-Postdoc mixer

Monday, April 4, 2022

8:00 am – 10:00 am	Division sessions (showcases/awards)
10:00 am – 12:00 pm	Poster presentations including the ASPET Datablitz
12:00 pm – 1:00 pm	Break for lunch with a colleague
1:00 pm – 3:00 pm	Division sessions (showcases/awards)
3:30 pm – 5:00 pm	Concurrent symposia
5:30 pm – 7:00 pm	Division mixers

Tuesday, April 5, 2022

8:00 am – 9:30 am	Concurrent symposia
10:00 am – 12:00 pm	Poster presentations including the ASPET Datablitz
12:00 pm – 1:00 pm	Break for lunch with a colleague
1:00 pm – 1:45 pm	Award lecture
2:00 pm – 3:30 pm	Concurrent symposia
3:30 pm – 4:30 pm	Poster Awards and closing networking event

Symposia Highlights

Saturday, April 2

Julius Axelrod Award Symposium and Lecture: GPCRs and G-Protein Signaling: Insights into Disease

The 2021 Axelrod Awardee, Joan Heller Brown, has organized a fast-paced symposium that will include her award lecture. It is now appreciated that G-protein coupled receptors and G-protein signaling pathways regulate chronic responses mediated through changes in gene transcription. Dr. Heller Brown will discuss studies that began with G-protein regulation of astrocyte growth and of cardiomyocyte hypertrophy, and lead to discovery of pathways critical for glioblastoma tumorgenesis and development of heart failure. Immediately following we'll hear from Stefan Offermanns exploring novel GPCRs regulating metabolic disease, Gerald Dorn discussing G-proteins in mitochondrial dynamics and heart disease, and wrap up with a talk from Bryan Roth about GPCRs in psychiatric disorders.

Targeting Autophagy in Cancer

This session will discuss recent advances in targeting autophagy as a treatment for cancer. Four leading investigators will discuss recent advances in the field that explain how autophagy modulation in cancer can affect anti-tumor immunity, how lysosomes regulate cancer behavior, the development of new autophagy inhibitors that target the lysosome in novel ways, and how cancer cell resistance to autophagy inhibitors can arise and may be circumvented.

Induction of Early Onset Cardiovascular Disease by Methamphetamine

Amphetamine-type stimulants are the most widely used class of illicit drugs in the world after cannabinoids, and there is a growing epidemic in illicit methamphetamine use. Methamphetamine can have adverse and potentially fatal effects on arteries and blood vessels, including elevated blood pressure, acute vasospasm, and atherosclerotic cardiovascular disease, and methamphetamine induces structural and electrical remodeling of cardiac tissue. This symposium will present human and animal studies regarding the impact of methamphetamine on the cardiovascular system, and discuss the findings that individuals exposed to methamphetamine present with early onset cardiovascular disease.

Automating the Patient-Oriented Problem-Solving Sessions in Pharmacology

The new Automated Patient-Oriented Problem-Solving System in Pharmacology provides an online platform for problem-solving exercises, active learning, and interprofessional education in pharmacology. With the Automated POPS, students can meet remotely or in person. Breakout groups can run simultaneously or asynchronously. The system records extensive student performance metrics and provides instantaneous feedback. Attendees should bring a laptop or tablet to use to do a run-through of an Automated POPS exercise.

Student-Postdoc Colloquium

Each year this popular colloquium focuses on career development topics of special interest to young scientists. Visit the online program at **www.aspet.org/eb2022/program** later this Fall for more details.

Immunotherapies for Substance Use Disorders: State-of-the-Art Approaches

Deaths attributed to synthetic opioids, such as fentanyl, and stimulants, such as cocaine and methamphetamine, have increased tremendously in the past year. Although several effective medications are available for treating opioid use disorder, relapse rates are high and medications for treating opioid overdose, such as naloxone, may be less effective against synthetic opioids compared to heroin. No medications have been approved in the U.S. for treating stimulant use disorders. Monoclonal antibodies and vaccines represent an alternative approach to treating overdose and substance use disorders. This symposium will provide an update on immunotherapies that are currently in clinical testing.

Novel Microphysiological and Microtissue Systems to Advance Transporter Research

Recent advances in the development of novel testing systems that recapitulate the human microenvironment and microanatomy have advanced drug and chemical screening. Using microphysiological systems, investigators are able to consider the influence of fluid flow, cell-cell communication, extracellular matrix, and 3-dimensional organization in organs-on-a-chip and tissue-engineered organ constructs and microtissues. Advancement of this technology includes the robust characterization of transporter expression and function, often in concert with evaluation of drug metabolizing enzymes and regulatory factors. This session will highlight examples of microfluidic systems and novel tissue cultures that recapitulate human transporter function across a number of organ systems. Speakers will review the potential application of these model systems for drug development and toxicity screening.

Pharmacology Perspectives on Attaining Diversity, Equity and Inclusion in Clinical Trials

This symposium aims to increase awareness of the ongoing and pervasive issues surrounding inequality in clinical trial development and provide insights on how these factors impact the validity and use of clinical trial results that currently perpetuate health disparities. This symposium will highlight the pharmacological insights and novel strategies to diversify scientific approaches involved in pharmacotherapeutic clinical trial design, execution and outcome analysis to overcome barriers for patients from underrepresented populations. The symposium will provide unique perspectives from leaders in the field of pharmacology representing a broad range of disciplines (industry, academia, government). The speakers have been selected based on their alignment with pharmacological scientific approaches and will present on topics of interest to a broad group of preclinical and clinical pharmacologists.

Sunday, April 3

Opioid Dependence and Non-Canonical Targets for Medication Development

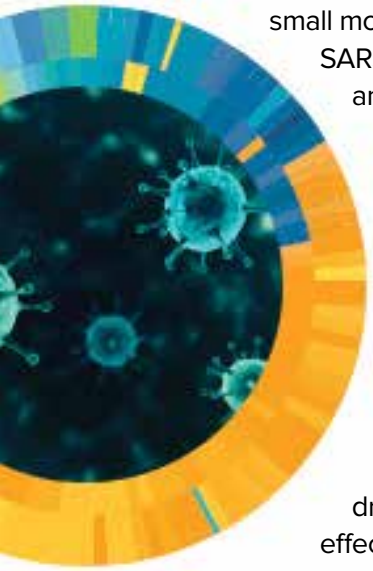
Opioid use disorder (OUD) is a leading cause of morbidity and mortality in the United States. Yet very few therapeutic options are available to individuals suffering from opioid use disorder, indicating novel drug development for OUD is critically needed. This panel, chaired by Dr. Jill Turner, the 2021 Division for Neuropharmacology Early Career Awardee, will discuss new and exciting directions in medication development for this debilitating disorder, centered on modulating neuroinflammatory responses to opioid exposure and withdrawal.

Targeting Gq Signaling in Disease

The heterotrimeric Gq protein family plays an important role in regulating signaling through a number of effectors. Gq signaling has been implicated in a number of diseases including asthma and uveal melanoma. Several inhibitors have been identified that can effectively and specifically inhibit Gq including constitutively active Gq mutants found in some cancers. The goal of this symposium, chaired by Dr. Jeffrey Benovic, is to provide: 1) insight into the development of Gq inhibitors that might be used to treat various diseases; 2) insight into the use of Gq inhibitors to treat disease; and 3) mechanistic insight into Gq inhibitor function.

COVID-19 Vaccines and the Virus: Impact on Drug Metabolism and Pharmacokinetics

Acute infection and inflammation transiently suppress hepatic drug metabolism. This session will discuss clinical cases supporting altered pharmacokinetics of small molecules and biologics following SARS-CoV-2 infection or immunization and examine the mechanisms of interactions between the innate immune response and small molecule and biologic metabolism following SARS-CoV-2 infection or immunization. Understanding the impact of emerging infections and vaccine technologies on drug metabolism will help mitigate drug toxicity and improve drug and vaccine safety and effectiveness.



COVID-19: Long Haul Symptoms, Testing and Impact of Environmental Exposures

The emergence of the SARS-CoV-2 virus in 2019 precipitated a cataclysmic global pandemic. This symposium will focus on various timely issues related to this epidemic. The first presentation will focus on long haul symptoms of Covid-19 infection. The second speaker will present on the transition of her laboratory from basic research to development of a novel Covid-19 diagnostic test. The third presentation will discuss the potential effects of vaping on the immune response to respiratory viruses. Taken together, this program will cover a range of issues related to Covid-19, ranging from long haul Covid and testing to environmental exposure and susceptibility.

Taking Care of Business: Funding Drug Discovery through the SBIR/STTR Programs

The Small Business Innovation Research (SBIR) and Small Business Tech Transfer (STTR) programs are congressionally-mandated programs that allow federal agencies to fund promising technologies that fulfill their missions. SBIR/STTR grants through the NIH and NSF are a valuable resource to academic pharmacologists and early-stage entrepreneurs looking to bring their new therapeutics to the market. This panel will feature NIH and NSF program staff, SBIR/STTR awardees, and reviewers who have served on SBIR/STTR study sections and provide information for pharmacologists who are interested in pursuing these opportunities.

Behavioral Paradigms to Model Substance Use Disorders in Animals

Although standard intravenous drug self-administration procedures remain the gold-standard for assessing the abuse potential of psychoactive drugs, substance use disorders (SUDs) are complex, multifaceted, and not fully recapitulated by any single animal model. Recently, novel behavioral paradigms have been developed to model specific aspects of SUD to better understand the neurobiology of individual vulnerabilities to develop SUD-related behaviors, and to evaluate candidate medications for treating SUDs. After a brief introduction on the use of animal models of SUDs, three speakers will discuss their research evaluating SUD-related phenotypes in rats, the use of drug-food choice procedures, and a social-operant choice assay.

Envisioning the Scope of Pharmacology Education for the Next Decade

Pharmacology educators are looking for guidance on incorporating the most essential drugs while fostering deeper understanding in their learners and avoiding cognitive overload. This session will address the challenges of balancing these demands. Participants will be assigned to a working group using either a) hypertension or b) diabetes as a model disease state and they will be asked to refine an expansive drug list, learning objectives, and effective teaching pedagogies for the disease state. Large group discussion will follow about this process and whether ASPET should engage in this work more frequently. Participants will leave with their team-curated lists.

Diversity and Inclusion Session

This popular breakfast session is organized by the ASPET Mentoring and Career Development Committee. Visit the online program at **www.aspet.org/eb2022/program** later this Fall for more details.

Monday, April 4

ASPET Presidential Symposium: The Intersectionality of Health Disparities: Pharmacology, Prescribing Bias and Social Determinants of Health

ASPET president, Dr. Peggy Gnegy and session co-chair Dr. Jayne Reuben have organized a symposium that will address the complex intersection of mechanisms, practices, and beliefs that impact clinical outcomes and research approaches in the development of pharmacological treatment for diverse populations.

$GABA_A$ Receptor Subtypes as Targets for Fast-Acting Antidepressants

This session will explore the role of inhibitory neurotransmission and specifically of molecularly defined $GABA_A$ receptor subtypes in the response to chronic stress, which has been implicated in the development of depression. Speakers will present basic science and translational aspects linking different $GABA_A$ receptor subtypes to depressive-like behaviors. A combination of pharmacological, biochemical, molecular modeling, medicinal chemistry, electrophysiological and behavioral approaches has been applied to elucidate the mechanisms behind the surprising observation that both positive and negative allosteric modulation of a5-containing $GABA_A$ receptors exhibit fast antidepressant actions and the suitability of this receptor subtype as a drug target for a novel class of antidepressants will be discussed.

Journals Workshop: An Interactive Guide to Publishing, Reviewing, and Ethics Issues

Sponsored by the ASPET Publications Committee, this session will feature the editors of ASPET's journals who will lead an interactive workshop to address journal-related issues such as manuscript preparation, the review process and being a good reviewer, publishing ethics, and copyright issues. A discussion about why researchers should choose ASPET journals, taking the mystery out of publishing, the review process, and how decisions are made, and a talk on ethics issues and open access.

Importance of Prodrug-activating Enzymes in Drug Development and Precision Pharmacotherapy

This session will discuss how genetic variants and tissue-specific expression of drug-metabolizing enzymes could affect the activation, pharmacokinetics, and therapeutic efficacy of various prodrugs with a focus on antiviral and anticancer medications. The session will stimulate the discussion regarding how to use genetic variants and tissue-specific proteomics information of drug-metabolizing enzymes to improve the design and delivery of prodrugs and enhance the efficacy and safety of prodrug pharmacotherapy.

Are You Measuring What You Think You Are? Writing Board-Style Multiple Choice Questions

Health science educators are often tasked with creating relevant exam items without training in question-writing, resulting in questions that are too easy or too difficult with overall low discrimination ability. Due to the COVID-19 pandemic, question banks have been depleted or compromised as a result of wide-spread remote virtual testing. This interactive, skills-building workshop will provide educators with the opportunity to learn the basic steps of writing board-style examination questions and actively work together to improve their own questions using constructive peer feedback. This will help faculty towards developing versatility in item-writing skills based on curricular needs and exam stakes.

Division-focused sessions

Join your division for a session focused on the top science in your specialty or be inspired by the latest research in a related specialty.

Division for Behavioral Pharmacology

Postdoctoral Showcase and P.B. Dews Award Lecture

Submit your abstract to the Behavioral Pharmacology topic categories numbered 3017 or 3018 to be considered for this oral presentation competition. Additionally, during this session, the winner of the 2020 P. B. Dews Award for Research in Behavioral Pharmacology, Dr. Linda A. Dykstra from the University of North Carolina at Chapel Hill will deliver the P.B. Dews Award Lecture.

Division for Cardiovascular Pharmacology

Trainee Showcase and the Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology

This session will feature the Trainee Showcase oral presentations by young scientists. Graduate students and postdocs are encouraged to submit their abstracts to the Cardiovascular Pharmacology topic categories numbered 3005-3010 to be considered for this competition. The session will also include award presentations from both the 2022 Early Career awardee and the 2022 Mid-Career Awardee. The 2020 awardee of the Paul M. Vanhoutte Distinguished Lectureship, Dr. Jan Danser from Erasmus Medical Center, will deliver the keynote address.

Division for Cancer Pharmacology

Young Investigators Symposium and Susan B. Horwitz Award Lecture in Cancer Pharmacology

Submit your abstract to the Cancer Pharmacology topic categories numbered 3000-3004 to be considered for an oral presentation in this young investigators symposium. This session will also feature a keynote from the 2022 Susan B. Horwitz Award in Cancer Pharmacology lecturer.

Division for Drug Discovery and Development

Scientific Achievement Award Lecture and Notable Abstracts Platform Presentations

Submit your abstract to the topic category "3022-ASPET Drug Discovery and Development" to be considered for these platform presentations. Additionally, the session will feature a keynote from the 2022 Scientific Achievement in Drug Discovery and Development awardee.

Division for Drug Metabolism and Disposition

Bernard B. Brodie Award, Gillette Awards, and Junior Investigator Platform Session

This session will feature a lecture by the 2022 winner of the Bernard B. Brodie Award as well as talks from the authors of the two best papers of 2021 from the journal of *Drug Metabolism and Disposition* who received the James R. Gillette Awards in pharmacokinetics (transporters) and drug metabolizing enzymes. The session will also include abstract-based oral presentations from graduate students and postdoctoral fellows. Submit your abstract to the Drug Metabolism and Disposition topic categories numbered 3023-3027 to be considered for the platform session.

Division for Molecular Pharmacology

Early Career Award Lecture and Postdoc Competition

Postdoctoral trainees are encouraged to submit their abstracts to the Cellular and Molecular Pharmacology topic categories numbered 3011-3016 to be considered for this competition. The session will also include a keynote lecture from the molecular pharmacology early career award winner.

Division for Neuropharmacology

Early Career Award Lecture and Postdoctoral Fellow Showcase

Postdoctoral trainees are encouraged to submit their abstracts to the Central Nervous System Pharmacology topic categories numbered 3019-3021 to be considered for this competition. The session will also include a keynote lecture from the neuropharmacology early career award winner.

Division for Toxicology

Highlights and Advances in Toxicology

Submit your abstract to the Toxicology topic categories numbered 3036-3041 to be considered for an oral presentation in this session.

Division for Translational and Clinical Pharmacology

Young Investigator Awards Platform and Early Career Faculty Showcase

Submit your abstract to the Pharmacogenomics and Translational Pharmacology topic categories numbered 3028-3034 to be considered for the young investigators award platform session. Additionally, the session will feature talks from the division's two Early Career Awardees.

Tuesday, April 5

ASPET "Guppy Tank" Translational Science Pitch Showcase

Members of the ASPET Young Scientists Committee, Yadira Perez Paramo and Khalid Garman have organized the 2nd ASPET Guppy Tank. This competition will showcase translational science pitches from four ASPET trainees who will be coached by mentors with established experience in the biotech, pharma, and entrepreneurship realms. In addition, the Guppy Tank event will feature a keynote discussion by a seasoned scientific entrepreneur who will highlight the importance of a translational vision to scientific innovations and effective strategies for a successful science pitch. This session will be an exciting and essential educational opportunity for ASPET trainees to hone their translational scientific communication skills while getting publicly recognized for their talents.

Developmental Neurotoxicity of Cannabinoids

Recent studies have revealed that cannabis is the second most used drug after alcohol in the US. Evidence shows that cannabis use in adolescents and young adults is associated with adverse neurocognitive reactions. Studies also show that cannabis use by pregnant women has been consistently increasing over time. Cannabis use among these special populations is expected to further increase with recent trends toward legalization of recreational consumption, representing a potential but great public health concern. This symposium is therefore timely with respect to understanding neurotoxicity of cannabinoids in infants and adolescents.

Evolution of Drug Resistance

This session will explore how cancers evolve resistance to therapies. It will explore the importance of tumor heterogeneity, both genetic and epigenetic, and the microenvironment in the evolution of drug resistance. Attendees will also learn about the tradeoffs associated with drug resistance, and how these costs can be exploited for the design of more effective and less toxic therapeutic regimen. The application of evolutionary approaches to understand and to treat cancers will be demonstrated for multiple malignancies, including breast and prostate cancers and multiple myeloma.

Ectopically Expressed Olfactory Receptors: Promises and Challenges of the Understudied GPCR Family

G protein-coupled receptors (GPCRs) are the arguably the most important drug target. About 50% of the ~800 GPCRs belong to the families of olfactory and taste receptors. While they were originally cloned from sensory organs, in the past decade expression of these genes was discovered in many other tissues. Technical difficulties with functional expression of these receptors in vitro and unavailability of tools for their analysis impeded progress in this field for many years. This session will highlight recent advances facilitating investigations of these understudied GPCRs and insights into their physiological functions, pharmacology and potential role in human disease.

The Importance of Pharmacology to Regenerative Medicine Innovation

Regenerative medicine, broadly defined, encompasses therapeutic interventions that replace, engineer or regenerate cells, tissues or organs to restore or establish normal physiology. Regenerative pharmacology is specifically focused on the biochemical stimulation of the body's own repair mechanisms to functionally heal previously irreparable tissues or organs. Integration of pharmacological approaches with the development of biomanufacturing, tissue/cell maturation and evaluation of tissue engineered constructs/products represent major opportunities for further expanding active areas of investigation. This symposium will explore the breadth of ways in

which pharmacology is woven into the very fabric of regenerative medicine.

G Protein Signaling in CNS Disorders

This session will focus on recently identified roles of G protein signaling components in brain disorders, pointing to novel therapeutic pathways. Translational studies highlight the essential role of regulator of G protein signaling 4 in the maintenance of chronic pain states, the importance of spinophilin/coffilin interaction in post-traumatic stress disorders, the impact of striatal cAMP signaling components on movement disorders and the impact of Gβγ–SNARE interaction on restoration of the release of hormones and neurotransmitters.

Teaching Blitz

Active learning approaches where students "learn by doing and thinking about what they are doing" have been established as being more effective than transmissionist approaches that rely on "teaching by telling." This symposium will showcase three exemplars of innovative and contemporary active learning strategies which enhance learner engagement and experience as well as learning outcomes, including gamification and augmented reality in pharmacology education. The audience will experience these learning and teaching methods through brief interactive demonstrations.

Program Committee Platform Session

Submit your abstract to any ASPET topic category numbered 3000-3044 by November 30th to be considered for this new session. Oral presentations will be selected by the ASPET Program Committee.

Featured Award Talks

The winner of the 2019 David Lehr Research Award, **Dr. Kathryn E. Meier**, will update us on her investigations that were funded by the award as she shares with us a saga of lipid mediators and their GPCRs.

The winner of the 2021 Axelrod Award, **Dr. Joan Heller Brown** will explore how GPCRs and G-proteins inform our understanding of disease.

In early January, we will announce the keynote lectures by the preeminent winners of the John J. Abel Award in Pharmacology, the Goodman and Gilman Award in Receptor Pharmacology and the Otto Krayer Award in Pharmacology.

Explore the full ASPET program at www.aspet.org/eb2022/program

Explore the full EB program at www.experimentalbiology.org

Explore the ASPET program by specialty area at: www.aspet.org/eb2022/divisions

Opportunities for Young Scientists

Undergraduates, post-baccalaureate students, graduate students, and postdoctoral scientists are encouraged to submit their abstract and attend EB. In addition to hearing the latest science, presenting their work, and networking, the following opportunities are also available:

ASPET Poster Competition

Application Deadline:
Tuesday, November 30, 2021, 11:59 pm PST

Poster awards are offered for outstanding poster presentations by ASPET student and postdoc members at a special evening poster competition. Submit your abstract to EB in an ASPET topic category by November 30. When prompted within the EB submission site, answer "yes" that you want to be considered for the ASPET Poster Competition.

We know many of you like to leave abstract submission to the last possible day. That's fine, but we strongly encourage you to prepare the following in advance:

- Have your membership ID# handy (it can be found under your member profile at www.aspet.org)
- Be sure your ASPET membership is up to date (or join now)
- Plan to be the first/presenting author
- Determine which ASPET topic category you will use www.aspet.org/eb2022/abstracts
- Check to be sure that you are eligible here: www.aspet.org/posterawards

Selected finalists will be announced in February. Presentations will take place at the ASPET Student–Postdoc Poster Competition on Sunday, April 3, 2022 in Philadelphia. You must be present to compete. All winners will be announced at the Closing Poster Awards and Networking Event on Tuesday, April 5 at 3:30 pm in Philadelphia.

For more information, please visit: www.aspet.org/posterawards

Submit your abstract and apply for poster awards here: www.experimentalbiology.org

ASPET Travel Awards

Application Deadline:
Monday, December 6, 2021, 8:00 pm ET

Young scientists are invited to apply for a travel award to help defray the costs of registration, travel, and housing to attend the ASPET Annual Meeting at EB 2022.

Step 1: Submit your abstract to EB in an ASPET topic category by November 30 at www.experimentalbiology.org

Step 2: Complete your ASPET travel award application by December 6 at www.aspet.org/travelawards

In addition to the general travel awards, ASPET also offers specialty awards for members of groups underrepresented in the biomedical sciences and for members residing in developing countries.

For more information and to apply for a travel award, please visit: www.aspet.org/travelawards

Oral Presentations

Application Deadline:
Tuesday, November 30, 2021, 11:59 pm PST

You may be selected for one of a variety of speaking opportunities at this international meeting. Students and postdocs need to submit their abstract to EB in an ASPET topic category by the November 30 deadline. No other application is necessary.

Opportunities include:

- 3-minute Datablitz talks
- Division showcases and platform talks (some include prizes!)
- Talks within the symposia listed above

ASPET Mentoring Network

The ASPET Mentoring Network is a professional development experience that uses career coaching to help participants develop the skills needed to succeed scientifically, professionally, and socially, including discussions about experiences and pressures faced by groups that are underrepresented in the sciences. This program kicks off at the ASPET Annual Meeting at EB but continues year-round. See page 179 for details.

ASPET Washington Fellows

The Washington Fellows Program enables developing and early career scientists interested in science policy to learn about and become more engaged in public policy issues. Fellows receive paid registration to the ASPET Annual Meeting at EB, but the program runs year-round. See page 177 for details.

Career Resources

While in Philadelphia, take advantage of these opportunities offered by all the EB societies in EB Career Central to develop your career in science:

- Interactive Workshops and Symposia – Career building topics led by expert speakers
- Roundtables – Small group career-development discussions with facilitators
- Short Talks – Power-packed tips for those with limited time between sessions
- Mentor Matching Programs – Navigate EB with someone who can also offer career advice
- Job Boards – Job openings across all areas of science

Featured ASPET career development sessions:

- Student–Postdoctoral Colloquium
- Journals Workshop: An Interactive Guide to Publishing, Reviewing, and Ethics Issues
- Undergraduate Networking and Career Development Luncheon
- Diversity and Inclusion Breakfast Session
- Taking Care of Business: Funding Drug Discovery through the SBIR/STTR Programs
- “Guppy Tank” Translational Science Pitch Showcase

Aspirin's Painless Journey

Rebecca J. Anderson, PhD

In the span of ten days, Felix Hoffmann synthesized two drugs and, without knowing it, changed pain management forever. The circumstances of Hoffmann's work have long been debated, but one fact is clear. He was the right person to come along at the right time and in the right place.

A Willowy Past

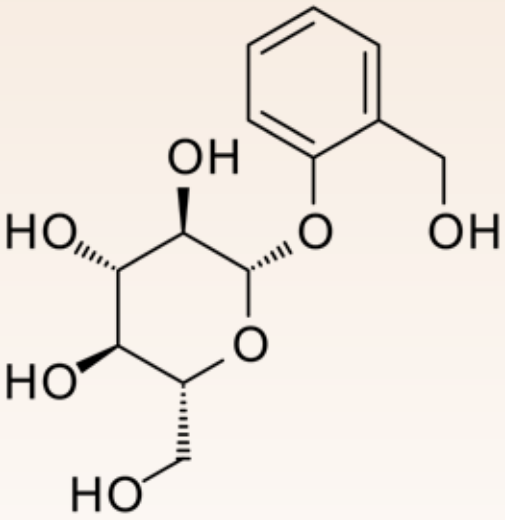
Since the beginning of recorded history—and undoubtedly long before—humans have used herbal remedies to alleviate pain, inflammation, and fevers. Native Americans, Africans, Asians, and Europeans all found that extracts from some widely available trees and plants provided relief *(1-4)*. Poplar bark, sweet birch bark, black cohosh root, meadowsweet, and wintergreen all contain salicylates and have medicinal properties. But willow tree bark was perhaps the most widely used.

The first clinical study of willow bark was documented by a country parson, Reverend Edward Stone. In 1758, he was looking for an inexpensive substitute for quinine to treat malarial fever *(5)*. After determining the optimal dose of a finely ground powder of the bark, Stone successfully treated about 50 patients in Oxfordshire, England *(2, 4, 5)*.

On April 25, 1763, he wrote a letter to George Parker, the president of the Royal Society, describing his findings *(2-4)*. Some physicians took note and began administering willow bark for fevers *(3)*.

The Salicylates

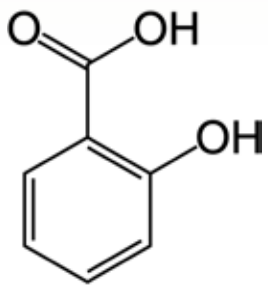
In 1828, Johann Büchner, a professor of pharmacy at Munich University, isolated yellow crystals from willow bark. He called the substance salicin (after *salix*, the Latin name for willow) *(1-4)*.



In the public domain

Chemical structure of salicin

In 1838, Raffaele Piria, an Italian chemist, isolated another substance from willow bark: salicylic acid *(2-4, 6)*. In 1859, Hermann Kolbe determined the chemical structure of salicylic acid and synthesized it *(2, 6, 7)*.



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Chemical structure of salicylic acid

Those salicylates were mostly chemists' curiosities. Salicylic acid was briefly used as a food preservative and to keep water fresh on long ocean voyages *(2)*. The first medicinal studies were conducted by Thomas Maclagan, a Scottish physician *(2, 3)*.

In 1874, Maclagan took salicin in increasing doses to satisfy himself that it was safe. Then, he gave it to a patient with rheumatic fever, and it brought down his temperature *(2, 5)*.

Over the next 2 years, Maclagan compared the outcome of rheumatic patients whom he treated with salicin versus untreated patients. In his published report in *The Lancet*, he called salicin "a speedy cure of the disease" *(8)*. It was as good as quinine and not as disagreeable. Maclagan emphasized fever lowering as salicin's most important property, but he also noted that it rapidly relieved pain *(8)*.

German physicians were simultaneously making similar observations *(2)*. A favorite remedy was an herbal tincture made from the meadowsweet plant to treat toothache and rheumatism. In Berlin, Karl Jacob Lowig extracted salicylic acid from meadowsweet, and like the herbal tincture, it reduced fever and alleviated pain *(2)*.

A few doctors subsequently prescribed salicylic acid, primarily for rheumatic fever. But in large doses, it irritated the mouth, esophagus, and stomach, leading to nausea, vomiting, bleeding, and ulcers *(1, 2)*. Many people were reluctant to take it a second time.

Maclagan found that both salicin and salicylic acid relieved the pain, tenderness, and swelling of rheumatism *(9)*. While salicylic acid caused tinnitus, the salicin-treated patients seemed to respond more quickly. This experience convinced him that salicin was the better remedy *(9)*. Unfortunately, salicin was harder to obtain and more expensive, so salicylic acid became more widely used *(9)*. Between 1877 and 1882, London's large teaching hospitals confirmed salicylic acid's effectiveness, and it joined the short list of plant-derived alkaloids (quinine, opiates, digitalis) with proven efficacy *(2)*.

To meet the growing demand for salicylic acid, Friedrich von Heyden established a large factory, the Heyden Chemical Company, in Dresden, Germany *(1, 2, 6)*. Heyden, a former student of Hermann Kolbe, used Kolbe's synthetic method, which was cheaper than extraction from willow bark *(6)*.

Coal Tar, From Dyes to Drugs

Throughout the 19th century, all of the top chemists had been trained at German universities or were taught by someone who had been. Among the many manufacturers that sprang from this expertise were the synthetic dye companies. They produced a variety of inexpensive textile dyes from aniline, a coal tar derivative *(2)*.

Tapping the abundant coal in the Ruhr Valley, German dye companies dominated the industry *(2)*. One of them was Friedrich Bayer & Company, which produced a popular aniline blue dye and the orange-red dye, alizarin.

In 1880, Friedrich Bayer died. His son-in-law changed the company name to Farbenfabriken vormals Friedrich Bayer & Company (the Dye Factory formerly known as Friedrich Bayer and Company) and turned it into a publicly traded company *(1, 2)*. He also funded promising doctoral and postdoctoral chemistry students, in exchange for a year of dye research at the company.

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Carl Duisberg

One of those students was Carl Duisberg. The bright young chemist created several new dyes and was soon put in charge of the company's research. When he was asked to find areas for company expansion, Duisberg noted that Hoechst, a nearby synthetic dye company, was successfully making and selling aniline analogs that had medicinal value. Hoechst's antipyrine and acetanilide were both fairly effective in reducing fevers *(1, 2)*.

Duisberg assigned one of his doctoral student apprentices to use the company's coal tar byproducts to make a compound that was more potent and had fewer side effects than acetanilide. The result was acetophenetidine, which Duisberg gave the trade name, Phenacetin. It was Farbenfabriken Bayer's first successful pharmaceutical product *(2)*.

But dye production was still the company's main business. The pharmaceutical chemists worked in corridors, under staircases, and even in an old wood shed. The early batches of Phenacetin were made in hundreds of discarded beer bottles, and workers hand-poured the powder into glass containers for distribution to pharmacists and hospitals *(2)*.

When Duisberg assumed responsibility for overall operations in 1890, one of his first actions was to build a proper pharmaceutical lab. The new drug division consisted of two sections: a pharmaceutical group that made new drugs and a pharmacology group that tested them *(2-4, 10)*.

Reinventing a Drug

In 1896, Arthur Eichengrün was appointed to head the pharmaceutical group. He was a flamboyant, charismatic, and brilliant chemist *(2-4)*. Eichengrün's management style reflected his academic background and emphasized intellectual freedom. Once he assigned a task, he left his colleagues alone until they had produced something or needed help and encouragement *(2)*.

In 1897, Eichengrün decided to find an antipyretic alternative that was free of salicylic acid's gastric irritation, nausea, and tinnitus *(2, 5, 11)*. He assigned the task to Felix Hoffmann.

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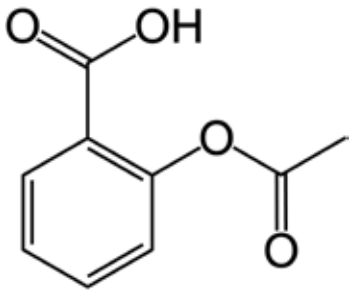
Felix Hoffmann

Hoffmann had studied pharmaceutical chemistry and conducted postgraduate research at Munich University. Although younger than Eichengrün, he had joined Farbenfabriken Bayer two years before his boss *(2, 3, 6, 7, 12)*.

Some historians have suggested that Hoffmann had a personal stake in his assignment. His father had been taking salicylic acid for rheumatism, and it caused unpleasant gastric irritation *(1, 2, 6, 7, 13)*.

While reviewing the literature, Hoffmann discovered that others had already tried to prepare salicylate analogs. In 1853, Charles Gerhardt, a professor of chemistry at Montpellier University, combined acetyl chloride with sodium salicylate to produce acetylsalicylic acid. The lengthy and tedious synthesis yielded only an unstable compound *(2-4, 7)*. So, Gerhardt abandoned the compound, thinking it had little practical use.



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Chemical structure of acetylsalicylic acid (aspirin)

In 1869, Karl Johann Kraut attempted to refine the synthetic method and was reasonably successful *(2)*. The Heyden Chemical Company then used Kraut's method to produce commercial supplies of acetylsalicylic acid *(2, 5, 7)*.

Hoffmann was quite familiar with acetylation reactions. Farbenfabriken Bayer's antipyretic Phenacetin (1888) is the acetylated form of para-nitrophenol, and its antidiarrheal Tannig (1894) is acetylated tannic acid. Adding the acetyl group had improved efficacy and decreased toxicity *(6, 14)*.

Using a different approach than Gerhardt's or Kraut's, Hoffmann combined acetic anhydride with salicylic acid (which had been extracted from the meadowsweet plant, *Spiraea alba*). His acetylsalicylic acid was chemically pure and stable *(7, 10, 12-14)*.

On August 10, 1897, Hoffmann wrote in his lab notebook that "due to its physical properties, such as an acid taste without any corrosive action, acetylsalicylic acid differs advantageously from salicylic acid and is being examined for its usefulness" *(11)*.

Pharmacology Testing

Heinrich Dreser

Hoffmann handed his compound to Heinrich Dreser, the head of the pharmacology group *(2, 3)*. After receiving his doctorate from Heidelberg University, Dreser worked in various labs before becoming a professor at Bonn University in 1893. He joined Farbenfabriken Bayer in April 1897, just a few months before Hoffmann's successful synthesis *(10, 11)*.

Dreser was a formidable character. The epitome of an eccentric German professor, he dressed extremely formally and dragged around an overweight dachshund. His autocratic manner and quick sarcastic views made him unpopular, and he frequently clashed with the more personable Eichengrün *(2, 10)*.

Carl Duisberg had created the pharmacology section to ensure that all drugs leaving Farbenfabriken Bayer were free of harmful side effects, and Dreser took his gatekeeper job seriously. He was the first industrial scientist to set up thorough, methodical animal studies, and many of them were innovative *(2, 10)*. He also introduced exacting bacteriological and toxicology procedures and oversaw clinical trials *(2)*. Under Dreser, the pharmacology section ran effectively and efficiently.

A few weeks after Hoffmann submitted acetylsalicylic acid, Dreser tested it. Eichengrün was present and impressed with the results *(2, 11)*. At a management meeting, he advocated moving ahead with clinical studies. But the decision to develop a drug candidate rested with Dreser, and he vetoed Eichengrün's recommendation *(10, 11)*. Dreser said that salicylic acid enfeebled the heart, and he believed—mistakenly—that acetylsalicylic acid would do the same *(2, 4, 10, 11)*.

A Heroic Diversion

The real reason that Dreser lacked enthusiasm was his preoccupation with another, more promising, drug candidate *(2, 4, 10)*.

When he was a professor, Dreser had studied the respiratory effects of codeine *(6)*. At that time, tuberculosis and pneumonia were leading causes of death, and even routine coughs could be severely incapacitating *(10, 14)*. Both morphine and codeine were effective cough suppressants, but they were also highly addictive.

Noting Farbenfabriken Bayer's success in detoxifying other drugs by adding an acetyl group, Dreser thought that acetylated morphine might be a non-addictive analog. While rummaging through the old scientific literature, he found an article written by C. R. Alder Wright *(2)*.

In 1874, Alder Wright had created diacetylmorphine, a white, odorless, crystalline powder *(10, 14)*. He tested it in dogs and quickly concluded that it was too toxic to be of use *(14, 15)*. He published his work in a local trade journal and shelved the compound.

Unlike Alder Wright, Dreser saw commercial potential. Dreser had no authority over the company's chemists, but nevertheless he asked Felix Hoffmann to replicate Alder Wright's work *(2, 6, 10)*. Ten days after Hoffmann prepared acetylsalicylic acid, he successfully synthesized diacetylmorphine and delivered it to Dreser *(7, 10, 13)*.

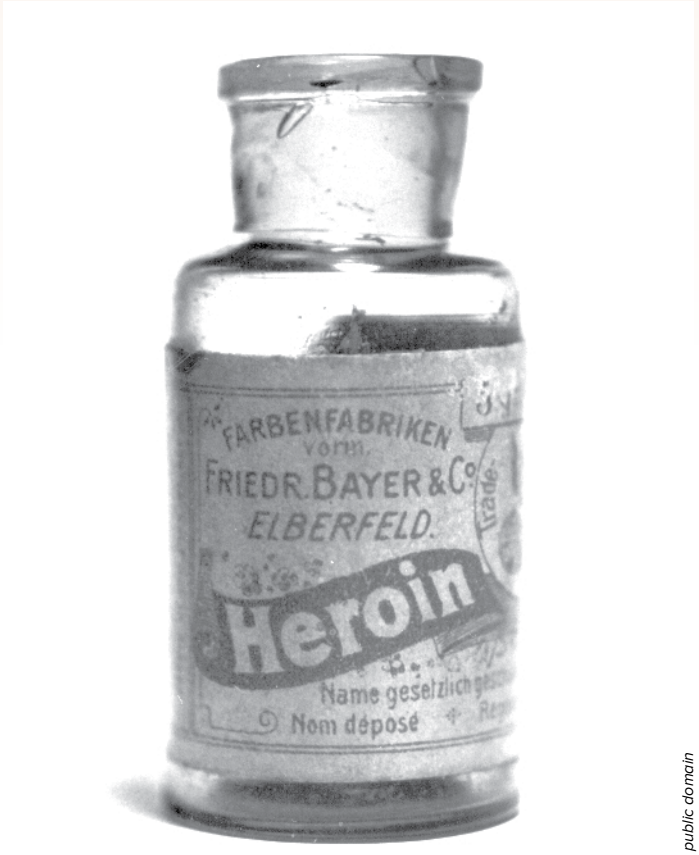
Dreser tested it on fish, frogs, and rabbits *(2, 10)*. Diacetylmorphine was four times stronger than morphine. He then took it himself and gave it to some volunteers in the company's dye factory. They experienced a feeling of heightened well-being *(2, 10)*.

Dreser's contract with Farbenfabriken Bayer guaranteed him a share of the profits of each drug

he developed, and this one looked like a winner *(10)*. The results of clinical trials suggested that diacetylmorphine was ten times more effective than codeine as a cough remedy and had one-tenth of its toxic effects. German chemists used "heroisch" to describe any strong drug, and in a medical context, "heroisch" conveys a sense of something extremely powerful *(10, 14)*.

In June 1898, Carl Duisberg gave diacetylmorphine the Bayer trademark name, Heroin® *(10, 15, 16)*. The respiratory suppression and sedative effects of Heroin permitted a restorative night's sleep and was a godsend. In addition to tubercular coughs, the company marketed it to physicians as a safe, non-addictive remedy for baby colic, colds, influenza, joint pain, and other ailments *(2, 4, 10, 15, 16)*. Within a year, Farbenfabriken Bayer was exporting Heroin to 23 countries *(10, 15)*.

But as early as 1899, doctors were reporting that Heroin caused tolerance, dependence, and addiction, and overdose victims were being rushed to hospitals *(10, 16)*. With Heroin showing signs of failure, Dreser turned, belatedly, to acetylsalicylic acid.



Heroin manufactured by Farbenfabriken Bayer

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Second Time Around

Meanwhile, Eichengrün had been moving ahead on his own, undeterred by Dreser's veto *(1-4)*. He took acetylsalicylic acid himself and found that it had no apparent effect on his heart *(3, 11)*.

He then sent small quantities to Felix Goldmann, the company's representative in Berlin. Goldmann distributed samples to his network of hospital physicians, general practitioners, and dentists *(2, 11)*.

Within weeks, the doctors sent back glowing assessments *(2, 11)*. This new drug relieved rheumatic symptoms without salicylic acid's unpleasant side effects. Also, it had another remarkable property: it was a general-purpose painkiller. One dentist noted that it quickly relieved a patient's toothache. Such rapid onset of pain relief was unique *(11)*.

Eichengrün circulated an internal report of these observations. Dreser—preoccupied at the time with Heroin—refused to accept it and scribbled in the margin of the report, "This is the usual Berlin boasting. The product has no value" *(2, 3, 11)*.

But their boss, Carl Duisberg, was intrigued and immediately ordered further testing. Acetylsalicylic acid was sent to several leading clinics, and the feedback was again glowing *(2, 3, 6, 11)*.

In September 1898, with Heroin's prospects already fading, Dreser re-examined acetylsalicylic acid *(11)*. He tested it on rabbits and took the compound himself, confirming it was safe *(4, 6. 10, 13)*. He then fast-tracked the new drug into production and patenting.

German authorities rejected Farbenfabriken Bayer's patent application because other chemists (Gerhardt and Kraut) had synthesized acetylsalicylic acid decades earlier *(2, 13)*. Most other countries also refused to patent it. The U.S. Patent Office, on the other hand, recognized Hoffmann's innovation: a new, stable synthetic method *(13)*. The U.S. patent was issued to Hoffmann and Farbenfabriken Bayer on February 27, 1900 *(17)*.

Aspirin

Carl Duisberg knew that a trademark could prove much more valuable than the patents. On January 23, 1899, Farbenfabriken Bayer's senior management, including Eichengrün, discussed brand names for acetylsalicylic acid *(2, 3)*. They took the root "spir" from the meadowsweet plant (*Spiraea alba*) and added the prefix "a" to denote the acetyl analog *(2, 3, 6, 7, 13)*. The suffix "in," a common ending for drug names at the time, was added to give Aspirin *(1)*. Farbenfabriken

Aspirin powder manufactured by Farbenfabriken Bayer

Bayer easily obtained trademarks for Aspirin® worldwide because it was genuinely a new word *(10)*.

To support the market launch in June 1899, Dreser wrote a promotional monograph, "Pharmacological facts about Aspirin (acetylsalicylic acid)" *(2, 10)*. It detailed the drug's chemical composition, test results (less toxic and superior to other salicylates), and therapeutic benefits *(1, 2, 11)*. But Dreser made no mention of Eichengrün and Hoffmann's contributions.

By this time, Eichengrün had moved to other projects at Farbenfabriken Bayer, where he made key contributions. His inventions and 18 major patents earned him a reputation as one of Germany's top pharmaceutical chemists *(2)*.

In 1908, Eichengrün left Farbenfabriken Bayer and set up his own factory in Berlin. His proprietary products included Cellit, an acetylic-cellulose that was used by Eastman Kodak and Pathé to make non-flammable camera film *(2, 3, 7, 11)*.

Bayer Aspirin

Like Heroin, Aspirin more or less sold itself, and by the time Heroin's problems emerged, Aspirin more than filled the gap *(10)*. As a painkiller with few side effects, it was (and remained for decades) unique. Within a year, Aspirin was being used all over Europe. In the U.S., Duisberg acquired a plant in Rensselaer, NY, to manufacture and market it *(2)*.

Doctors reported that, in addition to rheumatic fever and pain, Aspirin was a powerful remedy for headache, toothache, neuralgia, migraine, the common cold, influenza, tonsillitis, and arthritis. Sales soared. By 1906, it accounted for 25% of the company's U.S. sales *(2)*. And Farbenfabriken Bayer, thanks to Aspirin, became an industrial giant *(10)*.

Initially, Farbenfabriken Bayer distributed Aspirin to hospitals and clinics in glass bottles of white powder *(1, 11, 12)*. Pharmacists then prepared unmarked tablets, according to physicians' prescriptions. Consequently, doctors and pharmacists recognized Aspirin as a Farbenfabriken Bayer product, but consumers did not.

Because the U.S. patent was due to expire on February 27, 1917, the company took aggressive steps to establish the "Aspirin" brand before competitors were allowed to sell generic acetylsalicylic acid. For example, in 1915, Farbenfabriken Bayer began producing tablets, each stamped with the now-iconic Bayer logo: two perpendicular Bayer names that crossed at the central "y."

Saturation advertising also helped to cement the Aspirin brand. Between 1914 and 1917, American patients consumed almost 2 million pounds of Aspirin, valued at $25 million (about $620 million in today's currency) *(2)*.

When the U.S. entered World War I in 1917, the Trading with the Enemy Act authorized the U.S. government to seize all enemy property until the end of the war. Consequently, all of Farbenfabriken Bayer's U.S. assets, including its patents and trademarks, were seized, and Americans were appointed to the company's board *(2)*.

Following Germany's defeat, Farbenfabriken Bayer was forced to sell all of its U.S. assets as part of war reparations. At auction, Sterling Products, Inc., of Wheeling, WV, purchased those assets for a bargain basement $5.3 million. This included the massive Rensselaer plant, U.S. production and sales rights to all of Farbenfabriken Bayer's products, and its American trademarks *(6, 13)*.

Realizing Bayer's name was so powerfully linked to Aspirin, Sterling continued to market "Bayer Aspirin"

under its newly created subsidiary, Bayer Company of New York *(2)*.

Sterling aggressively guarded its market share of Bayer Aspirin, despite expiration of the U.S. patent. The key challenge centered on whether "aspirin" was a generic term for acetylsalicylic acid, or specifically denoted Sterling's brand, "Aspirin." If it was generic, anyone in the U.S. could call it aspirin. If not, the only company that could sell it in the U.S. under the name "Aspirin" was Sterling *(2)*.

After marathon legal battles, the courts concluded in 1921 that the word "aspirin" had passed into common use in the U.S., and the registration of "Aspirin" as a trademark was canceled *(6, 18)*. Similarly, in Britain and many other countries, aspirin is now considered a generic term. But in about 70 countries including Germany, Bayer still holds the Aspirin trademark *(2)*. Regardless, Bayer still displays the registered trademark (Bayer® Aspirin) in all of its literature.

Influenza

As a result of the Versailles treaty, signed on June 28, 1919, Farbenfabriken Bayer was required to turn over half of its stock of drugs and other chemicals in Germany to the Allies. That included Aspirin, the company's crown jewel, which was proving its value as a palliative treatment for influenza *(2)*.

During the 1918-1919 influenza pandemic, doctors searched in vain for remedies. Nothing seemed to work against the deadly secondary infections: pneumonia and bronchitis. But aspirin lowered the dangerously high fevers, eased the brain-splitting headaches and aching muscles and joints, and gave the body's natural defenses a chance to fight back *(1, 2)*.

"Between 1918 and 1920, aspirin sales doubled, and manufacturers went into overdrive to meet demand."

Between 1918 and 1920, aspirin sales doubled, and manufacturers went into overdrive to meet demand. Many millions of people who had never tried aspirin before benefited from it, and having used it once, they would take it again and again *(1, 2)*.

Playing Monopoly

Just prior to World War I, Carl Duisberg oversaw completion of a massive new Farbenfabriken Bayer facility in Leverkusen, on the banks of the Rhine River. He had also been trying to form a confederation of German chemical companies, along the lines of Standard Oil's monopoly in the U.S. Finally, in 1925, he succeeded *(2, 11)*.

The shareholders of Germany's six largest chemical companies, including Farbenfabriken Bayer, Hoechst, Agfa, and BASF, formed Interessengemeinschaft Farbenindustrie Aktiengellschaft, or IG Farben for short *(2)*. Each company maintained its identity and kept its own branded products, but they were now all subsidiary divisions of a single organization. They consulted each other on research, production, and sales, shared profits on a commonly agreed scale, and were managed by a single board of directors *(2)*.

Within a year, IG Farben became the largest corporation in the world. Collectively, it made and sold thousands of products, from drugs and explosives to dyes and synthetic petroleum *(2)*.

After Duisberg's death in 1935, IG Farben shifted priorities and provided major financial backing to the emerging Nazi Party. The cartel also supplied synthetic oil, rubber, and nitrates to further the Nazis' political and military goals. Its Degesch subsidiary produced Zyklon B, which was used in the gas chambers *(2)*.

In 1934, Albrecht Schmidt published a history of chemical engineering, emphasizing German achievements—and IG Farben's success in particular. Schmidt credited Felix Hoffmann with discovering Aspirin and made no mention of Arthur Eichengrün *(2)*.

That same year, the Nazis banned Jewish people from civil service and from holding professional positions *(11)*. Schmidt may have been persuaded to exclude Eichengrün, who was Jewish, from any connection to Farbenfabriken Bayer's greatest pharmaceutical product *(2)*.

In Berlin, Eichengrün was trying to keep a low profile. He had transferred half of his lucrative business to a Nazi supporter, and in 1938, he was forced to sell out entirely. In 1943, he was briefly imprisoned, and the following year he was deported to Theresienstadt concentration camp *(2, 3, 11)*. He was 76 and had recently developed diabetes *(2)*.

New Headaches

After the Nuremberg war tribunals, the Allied powers dismantled the IG Farben cartel, giving rise

to Hoechst, BASF, Agfa, and Farbenfabriken Bayer as independent companies. Farbenfabriken Bayer returned to producing pharmaceuticals, and Aspirin remained one of its most profitable products *(2)*.

In the U.S., the little white pills became a fixture in bathroom cabinets, desk drawers, and handbags *(2)*. But hundreds of competitors challenged Sterling's Bayer Aspirin. American Home Products sold Anacin® (aspirin and caffeine). Bristol Meyers made Bufferin® (a buffered form of aspirin) and Excedrin® (aspirin, acetaminophen, and caffeine).

McNeil Laboratories launched acetaminophen as a prescription drug in 1955. Later, Johnson & Johnson acquired McNeil, and Tylenol® became an over-the-counter drug in 1967. In 1984, American Home Products introduced Advil® (ibuprofen).

Faced with this strong competition, the market share of Sterling Products' Bayer Aspirin slipped significantly. Then, in December 1980, Sterling applied to the U.S. Food and Drug Administration (FDA) for a significant label change: "Aspirin has been shown to be effective in reducing the risk of death or reinfarction of patients who have suffered a myocardial infarction" *(2)*. Aspirin's heart attack prevention property had been studied for more than 30 years.

Nosebleed Inspiration

In the 1940s, Lawrence Craven, a family physician in Glendale, CA, was prescribing four sticks of Aspergum to tonsillectomy patients for post-operative pain. Unfortunately, some of those patients were re-hospitalized with profuse bleeding. Craven discovered that they had used much more gum. Some were chewing up to 20 sticks a day—equivalent to 12 standard aspirin tablets *(2, 3)*.

To verify his suspicion that aspirin caused the bleeding, he ingested 12 aspirin tablets for 5 days and experienced spontaneous, profuse nosebleeds *(4)*. He read clinical reports of aspirin-induced prolonged prothrombin time, which seemed to explain the bleeding episodes. He wondered whether this aspirin effect might also decrease the likelihood of a heart attack *(2, 4)*.

Between 1948 and 1950, he prescribed aspirin to 400 patients, and none suffered a heart attack. By 1956, he had settled on a prescription of one aspirin tablet daily for men between 45 and 65 years who were overweight and led sedentary lifestyles—factors that predispose a patient to heart attack *(4)*.

Altogether, he monitored 8,000 patients, and "not a single case of detectable coronary or cerebral thrombosis occurred among patients who faithfully adhered to this regime during a period of eight years" *(2)*.

Craven published several reports, but none included statistics or formal data listings. He acknowledged the limitations of his observations and urged others to conduct controlled clinical trials to confirm (or refute) his findings *(4)*.

Because Craven chose to publish in regional medical journals with few subscribers, physicians were largely unaware of his work *(4)*. Ironically, he died of a heart attack in 1957. To be fair, at age 74, he was outside the age range (45-65 years) for the prophylactic aspirin treatment he advocated *(4)*.

Aspirin Mechanisms

Ten years later, Harvey Weiss reported that aspirin inhibited platelet aggregation, but interestingly, sodium salicylate did not *(3, 19)*. This suggested that aspirin's antiplatelet activity was dependent on the added acetyl group. Weiss also found that aspirin's effect on platelets was rapid and irreversible. Platelets remained inhibited throughout their 10-day lifecycle *(4, 19)*.

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Sir John Robert Vane

In 1971, John Vane and his graduate student, Priscilla Piper, demonstrated that aspirin prevents the production and release of prostaglandin *(20)*. Later studies would show that aspirin selectively and irreversibly inhibits cyclooxygenase, the enzyme that generates prostaglandins *(1, 2, 4)*. The other well-known NSAIDs (e.g., ibuprofen, celecoxib) are reversible inhibitors *(1)*.

Tiny doses of aspirin (75 mg) prevent platelet aggregation *(2)*. At larger doses (300-600 mg), aspirin inhibits the prostaglandins responsible for pain, such as headaches *(2, 3)*. At much higher doses, aspirin reduces the swelling and pain of inflammation (such as in arthritis), again by inhibiting prostaglandins but also interfering with production of neutrophils *(3, 21)*. The mechanism of aspirin's selective fever-reducing effect (without affecting normal temperature) remains unclear *(2)*.

Stroke

Craven was interested in preventing heart attacks, but he also noted that none of his aspirin-treated

patients experienced a stroke *(4)*. In the mid-1960s, William Fields in Houston saw the reports that aspirin inhibits platelet aggregation and began one of the first clinical trials to study whether aspirin could prevent strokes *(2)*.

Other clinical trials confirmed the effect, and Sterling Products applied to the FDA for a label change. In 1980, aspirin became officially recognized as a stroke treatment *(2)*.

Attacking Heart Attacks

Convincing the FDA about heart attack prevention proved more difficult. Six controlled clinical trials, conducted in the U.K., Germany, and France, had been initiated in the 1970s. At first, investigators had some difficulty recruiting skeptical patients. "Come off it, Doc, what do these capsules really contain?" *(22)*.

All of those trials suggested that aspirin-treated patients suffered fewer heart attack deaths than those in the control group. But in each trial, this was only a trend and lacked statistical significance *(22)*.

Then, Richard Peto, a statistician at Oxford University, presented data that was highlighted in a 1980 *Lancet* editorial *(22, 23)*. Peto had combined the data from all six trials (more than 10,000 patients) using a mathematical construct—one of the first applications of meta-analysis using clinical data. He concluded that aspirin reduced the likelihood of deaths from a second heart attack by 20-25% *(23)*.

This prompted Sterling Products, a few months later, to ask the FDA for the label change. Many clinicians were already tentatively recommending aspirin to their heart patients *(2)*.

But unlike their stroke-prevention decision, the FDA remained unconvinced. Further clinical trials over the next few years helped to persuade them. In 1984, FDA's Advisory Committee unanimously recommended the change in Sterling's aspirin label *(2)*.

Hundreds of clinical trials were subsequently conducted, and aspirin is now an accepted prophylactic treatment for both heart attacks and stroke. The current recommendation is a daily dose of 75-160 mg, which is somewhat lower than that advocated by Craven *(4)*.

These studies, unlike Craven's observations, showed that aspirin does not completely prevent heart attacks or strokes, but rather significantly reduces the likelihood of a second episode *(4, 24)*. Because of the risk of bleeding, aspirin is not recommended for those who have never had a stroke or heart attack nor for those over age 70 *(24)*.

Rights Reclaimed

After World War II, Farbenfabriken Bayer evolved into a large modern pharmaceutical firm with a reputation for producing innovative, high-quality medicines. But the company, which was renamed Bayer AG in 1972, was still unable to sell any of its products under its name in the U.S. *(2)*.

For 40 years, Bayer AG waged an expensive legal battle with Sterling Products. Then, in 1988, Sterling was acquired by Eastman Kodak. In 1994, Eastman Kodak's Sterling Winthrop division was purchased by SmithKline Beecham for $2.95 billion. Bayer AG then struck a deal with SmithKline Beecham to buy back its North American operations for $1 billion—a colossal transaction that pleased SmithKline's stockholders *(1, 2, 6)*.

Finally, after 75 years, Bayer AG could once again sell its products under its own name in the U.S. *(2)*.

On March 6, 1999, the 100-year anniversary of Bayer's German trademark for Aspirin, workers unfurled a 400-foot-high banner that covered the Bayer AG headquarters tower building on the banks of the Rhine. The banner/building display looked like a gigantic box of Bayer Aspirin *(2)*.

"clinicaltrials.gov lists more than 50 clinical investigations of aspirin's effects on various types of cancer"

The Gift That Keeps Giving

Peter Elwood, a clinical investigator, has said "the beneficial effects of aspirin have probably been more conclusively established than those of any other drug" *(22)*. Hundreds of research studies investigating its therapeutic uses continue to appear each year *(7)*.

For example, citing aspirin's ability to inhibit prostaglandins, researchers speculated that it might slow tumor growth. In more than 20 observational studies, aspirin reduced the risk of colorectal cancer by up to 50%—an effect that is now well established *(2, 25)*. Studies have also shown that aspirin might limit the rate of growth and occurrence of prostate, pancreatic, and lung cancer *(1)*. Currently, clinicaltrials.gov lists more than 50 clinical investigations of aspirin's effects on various types of cancer.

The most recent application of aspirin has been to treat COVID-19. Critically ill COVID-19 patients exhibit heightened platelet aggregation *(21)*. Micro-clots are thought to contribute to the severe lung injury and hypoxia seen in these patients. Deep vein thrombosis and arterial thrombosis are common, and autopsies reveal platelet-rich clots in the heart, lungs, and kidneys *(21)*.

In an observational study of 412 COVID-19 patients, aspirin significantly lowered the need for mechanical ventilation and intensive care, as well as in-hospital mortality *(21)*.

"In an observational study of 412 COVID-19 patients, aspirin significantly lowered the need for mechanical ventilation and intensive care, as well as in-hospital mortality"

After Aspirin

Heinrich Dreser earned royalties on every drug he introduced, which amounted to more than 100,000 Deutsche Marks, on top of his substantial salary *(1-3, 10)*. By 1914, he was so rich that he decided not to renew his contract *(10)*.

He invested some of his wealth in a new pharmacological institute in Düsseldorf, where he served as an honorary, unsalaried professor *(2, 10)*. Ten years later, he died of a stroke, which might have been averted by a daily dose of aspirin—if its anticoagulant property had been known. Rumors circulated that he was addicted to heroin. One biographer observed, "Dreser appears to have taken a daily dose of the wrong wonder drug" *(10)*.

By contrast, Hoffmann and Eichengrün received no special compensation for their efforts. Shortly after making Aspirin and Heroin, Hoffmann transferred from the lab to an executive position in Farbenfabriken Bayer's marketing division. He remained there until his retirement in 1928 *(7)*.

Remarkably, Arthur Eichengrün survived the harsh conditions in Theresienstadt. After 14 months, he was liberated by the Soviet Army and made his way back to Berlin *(2, 3)*. But his personal possessions were gone, and he was unable to rebuild his business.

He and his wife retired to Bavaria, where he wrote, "Fifty years of aspirin." The paper, which was published shortly before his death in 1949, presented a straightforward account of Farbenfabriken Bayer's Aspirin and all of its principal contributors *(2, 3, 11)*. Eichengrün said, "Dreser had nothing whatsoever to do with the discovery, and Hoffmann carried out my chemical instructions in the first place without knowing the aim of the work" *(11)*.

Today, Bayer's official position is still that Hoffmann discovered aspirin and Dreser led the development efforts *(12)*. But it is clear that without Eichengrün's persistence and risk taking, Dreser's initial veto would have prevailed. Bayer Aspirin would not have seen the light of day *(2)*.

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Biosketch:

Rebecca J. Anderson holds a bachelor's in chemistry from Coe College and earned her doctorate in pharmacology from Georgetown University. She has 25 years of experience in pharmaceutical research and development and now works as a technical writer. Her most recent book is *Nevirapine and the Quest to End Pediatric AIDS*. Email rebeccanderson@msn.com.

In the next issue of *The Pharmacologist...*

Dr. Anderson will share the story of the Flint water crisis.

Don't miss the December 2021 issue.

Meeting News

Looking Forward to the ASPET 2023 Annual Meeting

As we announced last December, Experimental Biology will no longer be held after the 2022 meeting. This decision to end the Experimental Biology meeting came after the ASPET Council spent considerable time discussing the challenges facing our Society and our annual meeting, benchmarking with other successful scientific meetings, and analyzing data from our own membership surveys. While these discussions were taking place, ASPET and their longstanding partner societies mutually agreed to retire Experimental Biology. In 2023, ASPET will be holding an independent annual meeting.

A meeting strategy consultant was hired earlier this year to assist in research, analysis, and goal development to move us forward in our planning. Over 700 ASPET members provided feedback to our consultant through personal interviews, focus groups, and an online survey.

The key takeaways in their report to Council included having the meeting cover a wide breadth of pharmacology, involving and highlighting a diversity of voices, thinking, and processes in the field. This is representative of our members' view of ASPET as the home of pharmacology. They found the conference should be an experience that shows the connection of what people do, thus also highlighting their connections with each other.

They found this breadth of pharmacology needs to be delivered through hands-on experiences that encourage exploration. It marries the novel, the cutting edge with the hands-on in formats that are accessible to all during and after the event. It makes what is encountered, learned, and shared furthermore practical. Moreover, this means re-thinking timelines in order to foster the opportunity for up-to-date, novel, unpublished content to be presented.

They recommended that time and space should be engineered into the meeting for connection and networking. Attendees value opportunities for spontaneous casual conversation, which means scheduling quality free time and outside activities into the agenda. Furthermore, inviting spaces that are conducive to seeing and meeting friends and colleagues should be designed to help cultivate meaningful interaction within the meeting center. The conference should be focused and intimate. A smaller meeting is a great opportunity to connect. Creating an experience that feels relaxed and intimate reinforces that this is an event for its people. It highlights the value of participating, of belonging to a society. As ASPET looks at its next 100 years, it ensures that its legacy is actively lived on by its current members and those that are coming.

Over-Programming & Broad Content Approach

A common consensus was that ASPET meetings in the past have been over-programmed. Attendees want **fewer parallel sessions** so that they can attend more presentations outside of their field.

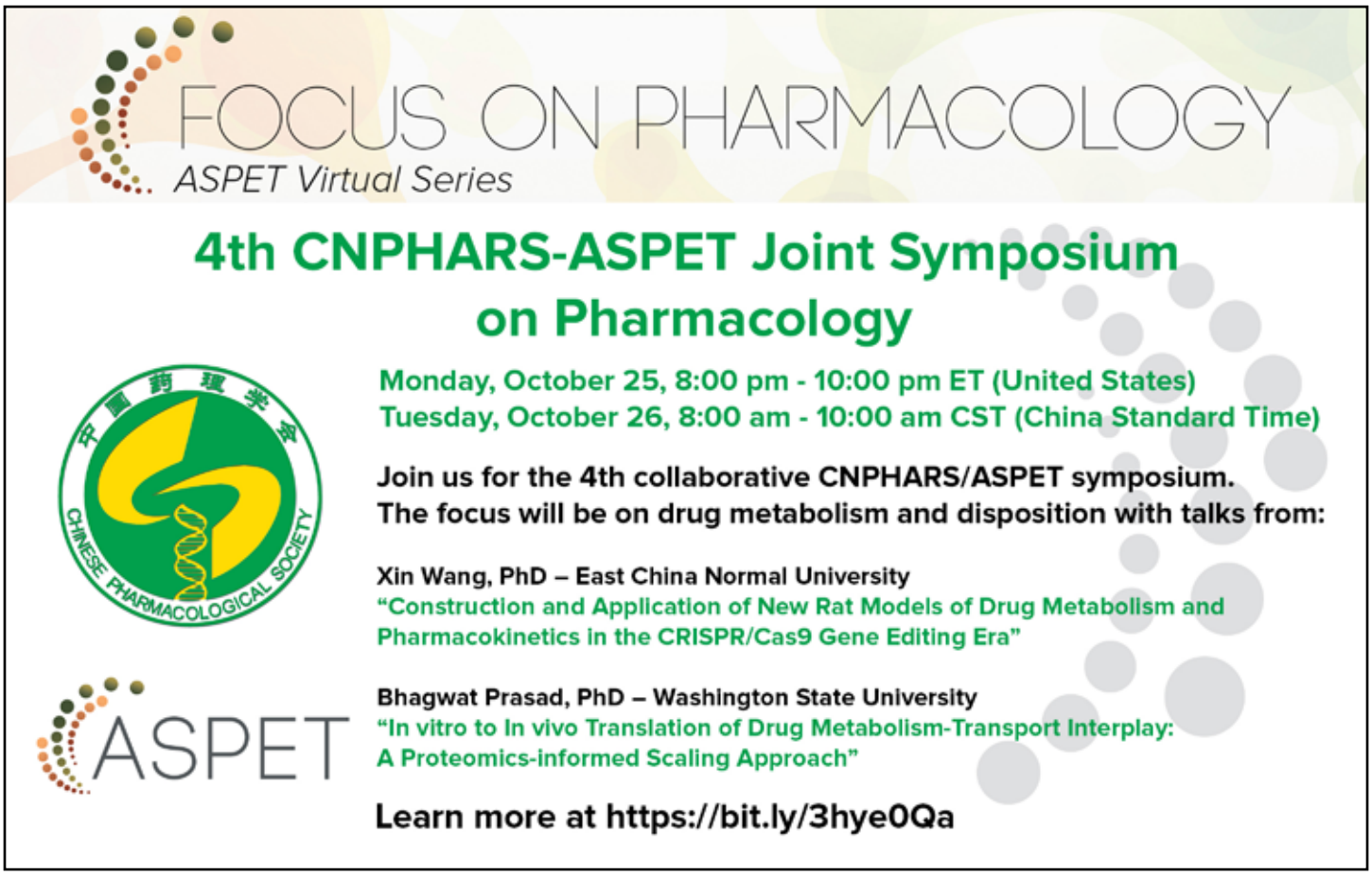
They advised that the meeting should be flexible and curated. Hands-on content modules engage diverse learning modes, and more information is delivered in an effective way. Likewise, shorter format content and interactive skill-building workshops should be integrated into the agenda as well to reflect attendees' desires. Segmentation of content by theme rather than division will help create cohesion and flow across sessions. Attendees want to attend talks in different division areas as long as the ideas and inspiration transcend a specific division and are understandable and contextualized.

The audience research suggested that planning for a virtual component for engagement will be important. This will allow for further inclusivity, expand the meeting's reach, provide value for those not able to attend in person, and respond to the desire of flexibility vocalized by the ASPET community.

The ASPET Council is further developing the strategic goals, budget parameters, and DEI strategy for the conference. The ASPET Program Committee is working to streamline and outline the session format, and ASPET staff are researching appropriate venues, designing session formats, and creating a plan for sponsor engagement. We continue to welcome member feedback throughout this process – contact us at meetings@aspet.org. We look forward to sharing more information as the meeting design progresses.

These recommendations were distilled into the following key goals for the Annual Meeting:

- **Be inclusive** to all participants and represent a diversity of voices.
- **Connect** people and topics across the field of pharmacology throughout the year.
- Present content that represents excellence in science, that is **interdisciplinary** and translational, and of value to our divisions.
- Ensure that the Home of Pharmacology is a place of **innovation**.
- Deliver **valuable** experiences that sustain the **growth and success** of ASPET.



Focus on Pharmacology Virtual Series

ASPET's Focus on Pharmacology Virtual Series was launched in July 2020 as a venue for communicating innovative science in pharmacology and experimental therapeutics. The webinars are broadcast live, and many have interactive components before, during, and after each session. The Focus on Pharmacology Virtual Series is free for ASPET members. Recordings of all the sessions are available on the ASPET*Connect* Focus on Pharmacology community.

Trainee Engagement in the Scientific Peer Review Process

Submitted by Courtney Bouchet, MS, Gisela A. Camacho-Hernandez, PhD, and Khalid Garman, PhD

Mentorship to become a scientific reviewer in the field of pharmacology often occurs during graduate or post-graduate time, although not all trainees have the chance to gain enough experience in this area. ASPET acknowledges the importance of giving trainees an additional venue to be trained or to expand their training as reviewers, especially at early stages in their careers. **ASPET Reviewer Academy** is an upcoming program for training young scientists on the peer review process led by Dr. Kathryn Meier, editor of *Molecular Pharmacology* who is also the associate dean for faculty and student development and professor of pharmaceutical sciences at Washington State University, College of Pharmacy. The Young Scientists Committee hosted a Focus on Pharmacology virtual webinar on June 23, 2021 on *Trainee Engagement in the Scientific Peer Review Process*, and Dr. Meier was the speaker of this event. The first part of the session focused on the editorial and review process, highlighting the importance of the reviewer role and best practices as a part of the Reviewer Academy curriculum. During the second part of the session, Dr. Meier discussed the Reviewer Academy proposal in depth. The Reviewer Academy will target senior graduate students, postdocs, and early career faculty.

One of the aims of the session was to get feedback from the attendees on the proposal. After the presentation there was a series of poll questions followed by a 15-minute breakout room discussion of the following questions: (1) What can young trainees add to the review process? (2) Does including young scientists in the review process help? (3) What should be the criteria for acceptance into the academy? Overall, the attendees thought that including early career scientists in the peer review process would be beneficial. This would enable trainees to learn more about the peer review process but ensure that they were getting training on the process as well. Other attendees expressed that implementing early training on the peer review process would improve the overall integrity and quality of their science.

As early career trainees, we found the session and proposal to be incredibly beneficial. The reviewer academy will be an invaluable venue for early career scientists to access the scientific review process with guidance from experienced senior scientists. If you missed the chance to attend this highly educational session, you can find the video recording in ASPET*Connect*. Visit https://bit.ly/3k1KItu to view the session.

Science Policy News

President Biden Proposes Creation of an Advanced Research Projects Agency for Health

This spring, President Biden debuted his proposal for the creation of the Advanced Research Projects Agency for Health, or "ARPA-H," to be housed within the National Institutes of Health (NIH). In a concept paper, the administration describes the mission of ARPA-H as "to make pivotal investments in break-through technologies and broadly applicable platforms, capabilities, resources, and solutions that have potential to transform important areas of medicine and health for the benefit of all patients and that cannot be readily accomplished through traditional research or commercial activity." Proposed areas where ARPA-H could focus its efforts include developing therapies and cures for diabetes, Alzheimer's, and infectious diseases. The administration envisions ARPA-H as a risk-taking agency, undeterred by the possibility of failure, with a less bureaucratic structure that will allow it to accelerate discoveries in medicine and health.

ARPA-H is modeled after the Defense Advanced Research Projects Agency, or "DARPA," housed within the Department of Defense. Following the launch of Sputnik, DARPA was created to make pivotal investments in breakthrough technologies to increase national security. DARPA is responsible for the development of the internet, GPS technology, and self-driving cars. DARPA has a distinctive organization and culture that its proponents credit as the driver of its successes. Program managers (PMs) are recruited from industry or research institutions and are funded for 3-5 years. They are encouraged to work on bold ideas with a milestone-based contract approach to achieve quantifiable goals. PMs also have significant authority to select and direct their own projects.

ARPA-H's structure would follow a similar model. Like DARPA, ARPA-H would have a flat and nimble organizational structure, tenure-limited program managers with a high degree of autonomy to select and fund projects, and metric-driven accountability. ARPA-H would be led by a director serving a five-year term. Recruitment of a high-profile director with significant project management expertise is considered paramount to the success of the initiative. Advocates of ARPA-H point to the Human Genome Project and the Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV) program as examples of breakthrough innovation in biomedical research. These two projects required DARPA-like approaches to achieve "moonshot" goals on accelerated timelines, and both were highly successful.

In justifying ARPA-H's placement within NIH, the administration notes that the goals of ARPA-H fall squarely within NIH's mission "to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability." Additionally, the administration envisions ARPA-H supplementing NIH and drawing on the biomedical expertise of the agency and its ecosystem, as opposed to being entirely separate from NIH. The close collaboration with NIH will also avoid unproductive duplication of scientific and administrative effort.

This summer, House Energy and Commerce committee members Reps. Diana DeGette (CO-1) and Fred Upton (MI-6) circulated a discussion draft of a proposal for a new 21st Century Cures bill to build on the 2016 bill. The potential new bill aims to improve health care access and delivery. Included in the discussion draft is an authorization for the creation of ARPA-H. ASPET provided a response to the discussion draft that requested stakeholder feedback on the ARPA-H proposal. In its feedback, ASPET thanked the

members for their commitment to funding biomedical research. ASPET also briefly outlined several concerns it has with ARPA-H. First, ARPA-H must not be allowed to siphon funding from basic science research. The new agency must have a budget distinct from National Institutes of Health (NIH) so that it does not grow at the expense of other NIH Institutes and Centers (IC). Second, ASPET shared concerns that efforts to create a distinct ARPA-H culture from NIH will be compromised by ARPA-H hiring NIH employees to staff ARPA-H. ASPET cautioned that the committee must take care in setting up the new agency. And last, ASPET noted that materials promoting ARPA-H do not make mention of substance abuse issues. This area is ripe for breakthroughs and should be a focus of the new agency. The discussion draft also included the Research Investment to Spark the Economy Act, which will provide $10 billion to the NIH and $3 billion to the National Science Foundation to help restore our nation's research capacity to its pre-pandemic strength and continue efforts to diversify our biomedical research workforce.

President Biden's FY 2022 budget requested $6.5 billion from Congress for the creation of ARPA-H. However, the House of Representatives allocated only $3 billion for ARPA-H in the Labor-HHS appropriations bill passed in July. The Senate has yet to pass its appropriation bills. The more modest allocation indicates that Congress supports ARPA-H, but also has questions on how the agency will be structured. ASPET will continue to monitor this situation and update our membership as the appropriations process continues into the fall.

Want more science advocacy news? Subscribe to ASPET's monthly *Prescribed Policy* newsletter!

http://www.aspet.org/aspet/advocacy/prescribed-policy-signup

2021 Washington Fellow Op-Ed

This year, the Washington Fellows program was entirely virtual, with fellows advocating for increases to funding for biomedical research and educating lawmakers and staff on the necessity of animal research from their home states via videoconferencing rather than traveling to Washington, D.C. to do so in person. Following their meetings, fellows were asked to write an op-ed that drew on their experiences learning about the policy-making process. Mark Namba, a neuroscience PhD candidate at Arizona State University, wrote his op-ed on a needle exchange law passed in his home state of Arizona. The op-ed was published in June by the *Arizona Republic* and is reproduced here with their permission as an example of the stellar work of our 2021 Washington Fellows class.

How A New Needle Exchange Law Will Help Arizona Fight the Opioid Crisis

Submitted by Mark Namba, Arizona State University

COVID-19 has added fuel to the flames of an opioid crisis that continues to engulf the nation.

But one bit of encouraging news emerged out of this year's Arizona legislative session: the sanctioning of needle and syringe exchange programs that could help slow drug overdoses and infectious disease spread.

According to the Centers for Disease Control and Prevention, opioid overdose deaths in the U.S., largely driven by the synthetic opioid fentanyl, spiked dramatically in the months following the onset of the pandemic. Maricopa County was not immune.

Drug overdoses are only one symptom of this ever-growing problem. The spreading of communicable

diseases such as HIV and hepatitis from injection drug use is a significant public health concern, and Maricopa County was recently identified as one of 50 localities accounting for the majority of new HIV cases in the U.S.

SB 1250 Protects Those Who Offer This Outreach

Senate Bill 1250, which passed with strong bipartisan support and was signed into law by Gov. Doug Ducey, provides legal protections for syringe service programs (SSPs), which allow individuals to exchange used syringes for clean ones.

Under previous Arizona law, individuals working for these outreach programs could be charged with possession of small quantities of illicit drugs (leftover in used syringes) and drug paraphernalia.

Such grave risks were counterproductive, given that SSPs provide many other essential health services, ranging from Narcan distribution to help minimize opioid overdose deaths to treatment referrals for those seeking rehabilitation.

Syringe service programs, in many cases, are the only form of health care for individuals battling with substance use disorders.

$1 For Needle Exchanges Can Save $6 On Health Care

For decades, scientists have known that community implementation of SSPs minimizes drug overdose deaths and the spread of infectious diseases. Studies have shown that SSPs, first established in 1988, can help reduce the incidence of HIV and hepatitis C by nearly half, or by over two-thirds when combined with medication-assisted treatment for substance abuse.

Moreover, the majority of SSPs offer treatment referrals to medication-assisted treatment, and individuals who seek help from such programs are more likely to enter treatment. SSPs also help keep the community and first responders, in particular, safe by keeping discarded needles off the streets.

These programs are also good for the economy. A 2014 cost-benefit analysis of syringe service programs found that for every dollar invested in them, more than six dollars are saved in health care costs.

While federal law now permits the use of federal funds to support SSPs, these funds still may not be used for the purchase of needles and syringes, a policy that contradicts a plethora of scientific studies showing the benefits of needle and syringe exchange.

Passage of SB 1250 finally weds public policy with those studies.

Arizona Can Now Set The Example For Other States

Previous versions of the legislation had made their way through the Legislature and failed. Senora Prevention Works, a Phoenix-based SSP with offices in Tucson and Prescott, expressed confidence – rightfully, it turned out – that SB 1250 would pass this year because it was driven by not one but six bipartisan members from the two chambers.

The legal protections now afforded groups like Senora Prevention Works should fully enable the efforts of SSPs and solidify their presence throughout the state.

Importantly, this legislation will provide a legal foundation for these organizations to more effectively reach vulnerable populations that are at a high risk for drug overdose and contracting preventable diseases.

More work is still needed at the federal level, such as reducing regulatory burdens that restrict how SSPs can use federal funds.

Arizona now has the opportunity to set an example for other states that still impose major legal barriers on syringe exchange programs. By enacting SB 1250 to protect SSPs, we are protecting the health and safety of our communities and promoting the well-being of all Arizonans.

2022 Washington Fellows Program

Submit your application by November 19, 2021

Program Mission

The mission of the ASPET Washington Fellows Program is to enable developing and early career scientists interested in science policy to learn about and become more engaged in public policy issues. Fellows will develop an understanding of how public policy decisions made in Washington help shape science policy, such as funding for the National Institutes of Health and other science agencies. Fellows will also learn how to advocate effectively on Capitol Hill and in their home districts. This program will help Fellows develop the skills and insights to become future leaders in science.

What Will ASPET Fellows Do?

- **Advocate on Capitol Hill:** ASPET Fellows will come to Washington, DC, to meet with their congressional delegation to advocate for increased federal support for biomedical research and increased funding for the NIH. Fellows will be well trained by ASPET and prepared with the appropriate message to deliver to Congress. ASPET will cover transportation costs, hotel, and other reasonable expenses that follow ASPET's reimbursement policy.

- **Become Advocates in their Home Districts:** Washington Fellows will have the opportunity to meet with members of Congress in their home districts, act as a conduit to inform colleagues within their departments/institutions about federal legislative matters, and write op-ed pieces to local papers on current science policy issues. All these activities will be undertaken with the support and advice of ASPET.

- **Attend the ASPET Annual Meeting at Experimental Biology 2022:** ASPET Fellows will receive complimentary registration to attend the 2022 ASPET Annual Meeting in Philadelphia, PA.

Who Should Apply?

The ASPET Washington Fellows Program is open to any graduate student, postdoctoral trainee, or researcher no more than four years past the completion of his/her postdoctoral training. **Applicants must be members of ASPET in good standing** and have a strong interest in science and its intersection with public policy. Fellows will be selected by the ASPET Science Policy Committee.

Application Information

ASPET anticipates up to 10 Washington Fellows Program participants in 2022. Fellows serve one-year terms.

All applications must be submitted by **November 19, 2021** online at:

www.aspet.org/washingtonfellowsprogram.

Incomplete applications or applications received after November 19, 2021 will not be considered.

Please feel free to contact **publicaffairs@aspet.org** with any questions.

"The ASPET Washington Fellows Program provided an excellent introduction to policy and advocacy, especially as someone with no prior experience in policy. Participating in the ASPET Washington Fellows Program solidified my desire to pursue a career in science policy."

-Bayli Dean, 2020 Washington Fellow

For more info:
www.aspet.org/ASPET_Washington_Fellows_Program
(301) 634-7060
publicaffairs@aspet.org

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Education News

ASPET joins LED-BIO, a new NSF-funded project examining cultural challenges in STEM

ASPET is collaborating on a new project funded through the National Science Foundation's LEAPS (Leading Cultural Change Through Professional Societies) mechanism. Entitled "Leveraging, Enhancing and Developing Biology (LED-BIO) Scientific Societies Shedding Light on Persistent Cultural Challenges," this project will identify and promote evidence-based inclusion strategies to: (1) collect consistent demographic data of society members, (2) better integrate scientists in transitional career stages into scientific society activities, and (3) diversify the ranks of scientific society leaders. By fulfilling these goals, this project aims to address persistent challenges that frequently undermine diversity, equity, and inclusion efforts within communities of scientists and to broadly share this information for the benefit of all scientific communities.

Scientific societies predominantly approach diversity, equity, and inclusion efforts by supporting the professional development of individual members who are from historically underrepresented groups in STEM. This approach of "fixing the individual" has not yielded more widespread change, and additional approaches are required to address the systemic inequities underpinning skewed demographics among STEM practitioners. The LEAPS mechanism views professional societies as key leverage points and agents of change, including structural, cultural, and social change. Funded projects are intended to be collaborative efforts among societies working to broaden participation and create a more inclusive and diverse scientific community.

This Research Coordination Network (RCN) project will use virtual town halls and in-person think tanks to expand and strengthen a cross-disciplinary network of communities of practice. This network will identify evidence-based strategies to address three persistent challenges that scientific societies face as identified by the Alliance to Catalyze Change for Equity in STEM Success (ACCESS; see more at https://stemaccessforall.org/): (1) lack of data to track scientific society membership demographic composition, (2) lack of integration of scientists in transitional stages of their careers into disciplinary communities, and (3) lack of diversity among highly visible thought leaders, including society leadership and speakers in scientific programs. This RCN is coordinated by ACCESS and its member societies (ASPET, the American Society for Biochemistry and Molecular Biology, the American Society for Cell Biology, the Endocrine Society, and the Biophysical Society), the Quality Education for Minorities Network, the Marine Biological Laboratories at Woods Hole, and the NSF INCLUDES Aspire Alliance. The resulting strategies and standards will be reported and disseminated through open access training materials and publications. The work is supported by NSF award #2134725 and will run from January 2022 through December 2024.

Graduate Students and Postdoctoral Scientists: Apply to Join the ASPET Mentoring Network

The ASPET Mentoring Network is a professional development program designed to supplement the training that graduate students and postdoctoral trainees receive through their universities. The ASPET Mentoring Network focuses on developing skills needed to succeed scientifically, professionally, and psychologically, including discussions about experiences and pressures faced by groups that are underrepresented in the sciences. As a professional development experience, the program uses a coaching model to help participants develop success skills for a variety of careers.

Graduate students and postdoctoral scientists accepted into the 2022-2023 program will attend several events in association with Experimental Biology 2022 in Philadelphia, PA. These will include training, guided discussions, an informal reception on Friday, April 1, and an interactive program on Saturday morning, April 2. During this time, trainees will meet the coaches and other trainees and become part of a six-person coaching group. Each trainee will also meet individually with their coach during the EB 2022 meeting and participate in virtual group meetings throughout the year, typically held as monthly conference calls or webinars. Group events will be tailored to the specific needs of each coaching group but may focus on work/life balance, interview skills, job searches, networking, grant writing, and other topics frequently identified as important to growth as a professional.

Who Is Eligible?

Graduate students and postdoctoral scientists who are members of ASPET in good standing are eligible to apply. Graduate students must have advanced to candidacy at the time of application. Postdoctoral scientists must be no more than 5 years past receipt of their terminal degree at the time of application. All applicants must be residents of the United States, Canada, or Mexico. If you're not a member, it's easy to join! Please visit https://www.aspet.org/membership/.

What Support Is Provided?

Applicants are strongly encouraged to apply for an ASPET travel award at www.aspet.org/travelawards. A limited number of travel awards will be available through the Mentoring Network to help defray travel expenses for those with significant financial need who do not have other support. You will be able to indicate your interest in one of these special travel awards during the application process.

What Is Required to Participate?

You must attend and participate in all Mentoring Network programming during EB 2022 and be an active participant with your coaching group for the year following. We are not able to accept participants who cannot attend EB 2022 in person or who are only available for a portion of the programming.

What Do Previous Participants Have to Say about the Program?

"Our group instantly connected with each other, and it was amazing to see how much we all had in common. We support each other and plan monthly goals, which motivates us to achieve them. Most importantly, sharing each other's experiences helps us gain valuable insights."

"Participating in the ASPET Mentoring Network has significantly expanded my network in the ASPET community and has provided me with wonderful mentors and fellow mentees that support each other both professionally and personally. I've enjoyed hearing

stories and getting career advice from a diverse group of people who are at different stages of their careers with varied experiences."

"I credit the Mentoring Network with helping me get my dream job in industry. The support of my coach and group members during the job application and interview process was invaluable."

"One memorable feature of the ASPET Mentoring Network is that it provides an open forum in which to discuss the ways our lives fit in and around science. Even though our discussions have been adeptly facilitated by established pharmacologists as mentors, of value to me has been the opportunity to interact with and learn from my peers. Despite many of us being in different pharmacology-focused fields, it is these relationships that will be most valuable as we all transition towards becoming independent scientists. I recommend participating in this program enthusiastically and without reservation."

"This served as an amazing support system for me. My group was a great sounding board for someone who works in a very small lab. I also feel like the activities at EB gave me a great tool kit to work with my PI to improve upon our mentor/mentee relationship."

How Do I Apply?

Applications for the ASPET Mentoring Network will open in October with a deadline of Monday, December 6, 2021. Please visit https://www.aspet.org/Education/ASPET_Mentoring_Network/ for additional details.

Volunteer to Be a Coach for the ASPET Mentoring Network

The **ASPET Mentoring Network** is looking for volunteers to train as coaches who will work with a group of six mentees in developing broad-based career skills. Coaching responsibilities include the following:

Prior to EB: Coaches will participate in training sessions with our Mentoring Network facilitators, including a one-hour conference call ahead of EB and an in-person session on Friday morning, April 1. The training is designed to introduce our coaching model, highlight facilitation approaches and strategies, and prepare coaches to navigate conversations with a diverse group of mentees.

During EB: Coaches will participate in programming at EB 2022 starting on Friday morning (April 1) and concluding Saturday morning (April 2), just prior to the start of EB 2022 in Philadelphia, PA. During the rest of EB, coaches are expected to meet individually with each trainee.

After EB: Coaches will participate in monthly virtual group meetings throughout the year. Group meetings will be tailored to the specific needs of each coaching group, but may focus on work/life balance, interview skills, communication, networking, and other topics frequently identified as important to growth as a professional.

Why Become a Coach?

Prior coaches have responded positively about their own experiences, overwhelmingly agreeing that the program was worthwhile. Many coaches have also emphasized how much they learned from interacting with their groups. According to one previous coach: "I learned to see life through their eyes, which was very educational for me. The idea of discussing differences in a non-threatening and supportive environment was excellent." Don't miss the opportunity to get involved with mentoring at ASPET! Coaches will be reimbursed for one hotel night (up to $300) and will receive paid registration for EB 2022 at the advance rate.

To apply to be a coach, please send your CV and a short statement of interest (maximum 250 words) to Catherine Fry (cfry@aspet.org**) by Monday, December 6, 2021.**

For more information contact Catherine L. Fry, PhD at cfry@aspet.org.

Apply to join the Academy of Pharmacology Educators

The purpose of the Academy of Pharmacology Educators is to provide a means to recognize senior and mid-career individuals who have made exemplary contributions to pharmacology education in the following areas: student-teacher interaction, innovative contributions, scholarly endeavors, and professional development and service. Applications are also encouraged from ASPET members who may be more junior in rank but who have chosen to focus their career goals on the education mission.

The application deadline is **Friday, January 14, 2022**. Applications submitted after that date will be reviewed the following year. Please carefully review the evaluation criteria, required components, and application instructions before you begin: https://www.aspet.org/aspet/membership-community/divisions/division-for-pharmacology-education-(dpe)/academy-of-pharmacology-educators.

Applications will be reviewed by at least three members of the Academy of Pharmacology Educators Membership Committee, which consists of the DPE Executive Committee and volunteer members. The Academy began in 2010 and now has 25 members among its ranks. Current fellows of the Academy can be viewed here: https://www.aspet.org/aspet/membership-community/divisions/division-for-pharmacology-education-(dpe)/academy-of-pharmacology-educators/fellows-of-the-academy-of-pharmacology-educators. We invite you to apply to join this distinguished group of educator-scholars!

Celebrating Peer Review Week, September 20-24, 2021!

PEER REVIEW WEEK
IDENTITY IN PEER REVIEW
SEPTEMBER 20-24, 2021

This year's theme, "Identity in Peer Review," was chosen by a community vote. A big thank you to all peer reviewers!

Journal News

Call for Papers on Non-Coding RNAs – *The Journal of Pharmacology and Experimental Therapeutics* Special Section

A special section on Non-Coding RNAs is being planned for publication in the August 2022 issue of *Journal of Pharmacology and Experimental Therapeutics*. The submission deadline is **January 5, 2022**.

Original research pertaining to innovative systems based on non-coding RNAs and their emerging clinical applications will be considered for this special section. Manuscripts describing efforts in demonstrating the role of non-coding RNAs as a biomarker of disease as well as their emerging functional role as targets to treat human disease are especially welcome. Research papers describing innovative in vitro/ex vivo/in vivo, bioanalytical, -omics, modeling, and/or clinical research approaches to advance the understanding of the biological properties of non-coding RNAs are highly encouraged. Reports on animal models addressing any of these topics will be considered if a clear translation to humans is shown.

Review articles addressing any aspects of the aforementioned topics will be considered as well; proposals for such articles should be sent to the guest editors, **Dr. Roberto Levi** (rlevi@med.cornell.edu) and/or **Dr. Gaetano Santulli** (gaetano.santulli@einsteinmed.org), for approval prior to submission.

Pharmacology Research & Perspectives introduces: Pharmacology Education and Innovation Series

PR&P has recently launched a new series with the title "Pharmacology Education and Innovation."

Articles published so far as part of this series can be found here: https://bpspubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)2052-1707.pharm-ed

Pharmacology education is an essential element of biomedical science and practice. Knowledge of drug action on biological systems, patient outcomes, and how the body responds to pharmacological interventions are key curricular competencies in schools of medicine, nursing, pharmacy, dentistry, physiotherapy, and veterinary medicine, particularly in the context of disease and variable physiological and clinical parameters.

In addition, emerging biomedical scientific developments require the continual evolution of pharmacology educational methodology and practices. Assessing the downstream utility and practice of such training in the research and clinical settings, by way of clinical efficacy, toxicity, and adverse prescribing behaviors provides valuable opportunities to evaluate the quality of educational outcomes in pharmacology.

Call for Papers – Now Open

Educational research-related papers have been a key component of the content published in *PR&P* in recent years. To build on this important feature of the journal and to further the advancement of

pharmacology education, *PR&P* has opened a call for papers on all aspects of current and future pharmacology education including:

- Curriculum development
- Learning strategies
- New pedagogical models
- Approaches to the delivery of pharmacology content

More information about this call for papers can be found on the call for papers page (found at https://bpspubs.onlinelibrary.wiley.com/hub/journal/20521707/cfp_pharmacology_education) and in the Editorial (found at https://bpspubs.onlinelibrary.wiley.com/doi/full/10.1002/prp2.772) by the Editor-in-Chief, Dr. Mike Jarvis, and Deputy Editor, Dr. Jennifer Martin.

Submission Requirements

As part of this series, we encourage submissions of all article types (e.g., Original Articles, Reviews, Commentaries). The *PR&P* Author Guidelines provide further information about submission requirements for manuscripts submitted as part of the series, and can be reviewed here: https://bpspubs.onlinelibrary.wiley.com/hub/journal/20521707/author-guidelines.html

APC Discount

Articles accepted as part of the Pharmacology Education and Innovation Series are also eligible for a **20% discount** on the Article Publication Charge, the details of which can be reviewed at: https://bpspubs.onlinelibrary.wiley.com/hub/journal/20521707/article-publication-charges.html.

Mohamed Ghonim Joins the Publications Committee

ASPET has a new Young Scientist representative to the Publications Committee. Dr. Mohamed Ghonim, a proud member of the Young Scientists Committee, is also currently serving as an Executive Committee Member in the ASPET Division for Translational and Clinical Pharmacology. He succeeds Dr. Joe Jilek on the Publications Committee, who served from 2018 to 2021.

Dr. Ghonim joined LSU Health Sciences Center in 2012 for graduate training. After receiving his PhD in immunology in 2016, he was awarded postdoctoral fellowships from both the American Society of Immunology (AAI) in 2017 and the American Heart Association (AHA) in 2019. Dr. Ghonim is a research scientist at St. Jude Children's Research Hospital and an adjunct assistant professor at the College of Pharmacy, Al-Azhar University in Cairo, Egypt. He has been an ASPET member since 2012 and is a member of the Divisions for Drug Discovery and Development, Cancer Pharmacology, Cardiovascular Pharmacology, Drug Metabolism and Disposition, Molecular Pharmacology, Pharmacology Education, Toxicology, and Translational and Clinical Pharmacology.

Highlighted Trainee Authors

Congratulations to the latest Highlighted Trainee Authors selected for *Drug Metabolism and Disposition*, *The Journal of Pharmacology and Experimental Therapeutics*, and *Molecular Pharmacology*:

Drug Metabolism and Disposition

- Serene Joseph (Temple Univ.) – June
- Ankit Balhara (Natl. Institute of Pharmaceutical Education and Research, India) – July
- Md Masud Parvez (Washington State Univ.) – August

Serene Joseph

Ankit Balhara

Md Masud Parvez

JPET

- Qingxiang (Nick) Lin (SUNY, Buffalo) – June
- Vivian Rodriguez-Cruz (SUNY, Buffalo) – July
- Allison Doyle Brackley (UT Health, San Antonio) – August

Qingxiang (Nick) Lin

Vivian Rodriguez-Cruz

Allison Doyle Brackley

Molecular Pharmacology

- Julliane Vasconcelos Joviano-Santos (Federal Univ. of São Paulo, Brazil) – June
- Rebecca Swan (Newcastle Univ.) – July
- Nicolas Senese (Univ. of Illinois at Chicago) – August

Julliane Vasconcelos Joviano-Santos

Rebecca Swan

Nicolas Senese

A brief description of their areas of research, current projects, the anticipated impact of their work, and what they enjoy when not in the lab is online at https://bit.ly/2yX1YeH. We congratulate all of them for being selected.

Membership News

The Value of ASPET Membership

ASPET works to fulfill the Society's mission of promoting pharmacology and to provide our members with the necessary tools to enhance their careers, expand their networks, and share their important research to transform discoveries into therapies. We asked ASPET member, Catherine Davis what ASPET membership has meant for her.

Catherine M. Davis, PhD is an ASPET member at Uniformed Services University of the Health Sciences. She joined ASPET in 2008.

Why did you join ASPET?

CD: I joined ASPET as a graduate student member to gain more opportunities for networking with other scientists, primarily those within the Division for Behavioral Pharmacology. Joining ASPET also provided me a great opportunity to present my research to a diverse group of people from different areas of pharmacology research.

How has membership in ASPET benefitted your career?

CD: My ASPET membership has not only provided me opportunities to present my research, but also opportunities to be involved with different aspects of society leadership. Through these roles, I have met additional ASPET members and have created a network of colleagues at many different institutions and career levels.

Why do you think it is important to attend the ASPET Annual Meeting at EB?

CD: Attending the annual meeting is important because it allows members to network with one another, share ideas and new data, and potentially recruit new members to their labs by meeting potential graduate students and post-docs. Further, it provides a great venue to learn about new and exciting research and possibly form new collaborations. Finally, I think it provides a great venue for trainees to showcase their work and meet other early-career members, which hopefully will encourage them to return to the meeting each year.

What advice would you give members who want to get more involved in ASPET?

CD: Yes, get involved!! You can get involved directly with your division, or you can work on committees for the society that are comprised of members from multiple divisions. If you aren't sure where to start, email the ASPET staff, your division leaders, or a committee chairperson to see when positions might be available. Since terms are usually 2-3 years for many volunteer positions, most committees are always looking for fresh faces and new ideas. Volunteering with the Society is a great way to effect the change you want to see. Notice an issue that you think needs to be addressed? Volunteer and share your creative ideas for strengthening your society!

What is the most helpful advice you were ever given throughout your career?

CD: Learning when to say no, which is something I'm still working on. We can often get overwhelmed with wanting to help every time we are asked, but it's not possible to do everything! Learning what things are important or need to be done and what might be left to someone else is an important part of time management and helps to avoid being overcommitted.

Renew Your ASPET Membership for 2022

Thank you for choosing to be a member of ASPET! We hope you are enjoying and utilizing all the benefits of membership. Renew your membership early so that you don't miss out on any exciting opportunities to grow your connections and advance your career.

How to Renew

Be sure to watch your email for the 2022 dues renewal notice this month. Don't want to wait for the email? You may complete your renewal online by visiting **www.aspet.org/renew** or by contacting Member Services at 301-634-7060. Thank you for your valued support of ASPET. We look forward to another amazing year!

New Members

Regular Members

Sandra D. Comer, Columbia Univ, NY
Nathan Dolloff Medical, Univ of South Carolina
Aditya D. Joshi, Univ of Oklahoma HSC
Andrew C. Kruse, Harvard Medical School, MA
Tudor I. Oprea, Univ of New Mexico
Jalees Rehman, Univ of Illinois, Chicago
Gregory C. Sartor, Univ of Connecticut
Nathan M. Sherer, Univ of Wisconsin-Madison
Peter W. Stacpoole, Univ of Florida
Ylva Terelius, Admeyt AB, Sweden
Morgane Thomsen, Mental Health Services, Capital Region of Denmark

Postdoctoral Members

Roaya Alqurashi, Umm Al-Qura Univ, Saudi Arabi
Vivaswath S. Ayyar, Janssen R&D LLC, PA
Biruk T. Birhanu, Kyungpook National Univ, Korea
Alex Mabou Tagne, Univ of California, Irvine
Michael Udoh, Univ of Sydney, Australia

Affiliate Members

Shareef J. Antar, Eurofins-Villapharma-Research, Spain
Kelechi W. Elechi, Servier Pharmaceutical Ltd, Nigeria

Graduate Students

Michael F. Almeida, Univ of North Carolina, Pembroke
Danielle L. Chappell, Univ of North Carolina, Chapel Hill
Andrew George, York Coll of Pennsylvania
Nathalie L. Momplaisir, Univ of Michigan
Ingrid Peterson, Univ of Arizona
Nicholas M. Ruel, Univ of Alberta, Canada
Joshua N. Wynn, Univ of North Carolina, Chapel Hill
Svetlana Zeveleva, Univ of Connecticut

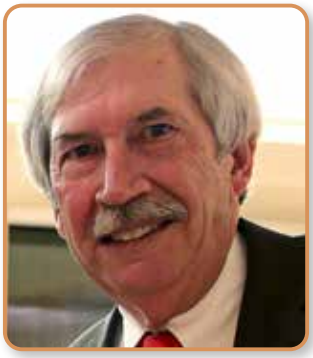
Undergraduate Students

Adeeba N. Ahmad, Univ of Texas, Rio Grande Valley
Amber Amparo, Univ of North Carolina
Lydia Arnold, Ohio Wesleyan Univ
Sarah Aviles, Northwestern State Univ, LA
Rija Awan, Univ of Michigan
Bradley B. Balk, Univ at Buffalo, NY
Natalie I. Belle, The Coll of Wooster, OH
Brianna M. Bembenek, Ripon Coll, WI
Anisha Bhattacharya, Rutgers Univ, NJ
Elizabeth Bianchine, Bucknell Univ, NJ
Aaron Blackwell, Univ of North Dakota, Hlth Sci Libr
Esther Bonitto, Dalhousie Univ, Canada
Kyle Browder, I, Arizona State Univ
Branna Campbell, Univ of North Carolina, Greensboro
Zoe Cappel, DePauw Univ, OH
Alexandra C. Castroverde, Cornell Univ Lib, IL
Karina Chao, Case Western Reserve Univ, OH
Hanna Chin, Univ of Rochester, NY
Hollie B. Clifton, Univ of Kentucky, Coll of Med

Cody M. Combs, Univ of North Dakota
Irene Corona-Avila, Albion College, GA
Kimberly I. Correia, Univ of Florida
Zakaria Dairi, Michigan State Univ
Champa B. Danappanavar, Michigan State Univ
Calista R. Dean, Morehead State Univ, KY
Diana Dinh, Purdue Univ, OH
Ethan Dintzner, The Univ of Chicago
Sarah Elkamhawy, Rutgers Univ, The State Univ of New Jersey
Rawda B. Elsayed, Rutgers Univ
Lauren Eng, Amherst Coll, NY
Mark E. Engelken, Iowa State Univ
Zachary C. Even, Univ of North Dakota, Hlth Sci Libr
Maria D. Ferreira, The Coll of Wooster, OH
Midori Flores, St. Mary's Univ, TX
Carson Florkowski, Univ of Kentucky, Coll of Medicine
Megan Gaines, North Carolina Central Univ
Marta Galagoza, Rutgers Univ, NJ
Abhishek Gangapurkar, Shri Govindram Seksaria Inst of Tech & Sci, India
Sarina Garcia, Univ of Texas, San Antonio
Isaiah Germolus, Univ of North Dakota
Eric Gliniak, Univ of Pittsburgh, PA
Matthew J. Granzotto, Hillsdale Coll, MI
Sephtis Hargrove, Eastern Washington Univ, WA
Jaron Harmon, Brigham Young Univ, NM
Grace Henry, Univ of Kentucky
Daniel P. Hu, New York Univ
Jasmine V. Jahad, Univ of North Carolina
Marisa Johnson, Washington State Univ
Malaika Kimmons, West Virginia Wesleyan Coll
Brianna Knode, Washington State Univ
Anna M. Lambertz, Univ of North Dakota
Olivia Laniak, Case Western Reserve Univ, NY
Kendra Lee, Roosevelt Univ, IL
Laura K. Lee, Louisiana State Univ, Shreveport
Brianna N. Lent, Univ of Arizona
Charlie C. Levy, Western Michigan Univ
Braden M. Lopez, Univ of Arizona
Chris R. Lordson, Pensacola Christian Coll, TX
Anthony Luis, Chapman Univ, CA
Insha Maknojia, Vanderbilt Univ, TX
Nicole Matter, South Dakota State Univ
Anna M. Monson, Michigan State Univ
Taina Moore, Tuskegee Univ, IL
Jonathan Nulman, Univ of Massachusetts
Ian O'Connor, Rutgers Univ, NJ
Katherine Oppenheimer, Univ of Pittsburgh, PA
Harith Palmer, Univ of Michigan
Jeffrey Pan, Case Western Reserve Univ, OH
Grace N. Parekh, Univ of Arizona
Isabel M. Parzecki, Rutgers State Univ, NJ
Megan Pfeifer, Univ of Pittsburgh, PA
Madison Purkerson, Univ of Miami, FL
Faraan Rahim, Duke Univ, NC
Anjali Raju, Case Western Reserve Univ, OH
Pranesh Ravichandran, Case Western Reserve Univ, OH
Carla Reyes Bermudez, Univ of Central Florida
Jarett Reyes George, Rutgers Univ, NJ
Alexa E. Richardson, Louisiana State Univ, Shrevenport
Mackenzie Ringer, Univ of Illinois, Chicago
Andrew R. Robbins, Case Western Reserve Univ, OH
Hannah E. Robinson, Rutgers Univ, NJ
Alexis R. Rodriguez, Univ of North Dakota
Maria Rollinger, Michigan State Univ
Bryson Rorie, Vanderbilt Univ Med Ctr, TN
Kincaid S. Rowbotham, Univ of North Dakota
Alex J. Roy, Michigan State Univ
Giselle R. Ruiz, Univ of Arizona
Radhey Ruparel, Univ of Arizona
Mackenzie E. Ryan, Washington State Univ
Khondker S. Salim, Rice Univ, TX
Manaal Salman, Baylor Univ, TX
Javier Santiago Perez , Univ of Puerto Rico, Rio Piedras Campus
Kiera E. Schwarz, James Madison Univ, VA
Ahssan Sekandari, Univ of Pittsburgh, PA
Riley Shin, Univ of Texas
Yolanda C. Simpson, Univ of North Carolina
Aman Singla, Univ of California, Davis
Kayla R. Snare, Univ of North Carolina, Chapel Hill
Jacqueline A. Spieles, Coll of Wooster, OH
Heidi Stifter, Wellesley Coll, TX
Jonida Trako, Univ of Michigan, Ann Arbor
Tuan Kiet Trinh, Univ of Michigan
Julia Trudeau, Loyola Marymount Univ, CA
Autumn E. Tucker, Univ of North Carolina, Chapel Hill
Lilly F. Visser, Gonzaga Univ, WA
Jalaysia A. Weems, Univ of Maryland
Adam B. Wier, Hillsdale Coll, KY
Alden L. Williams, Univ of Illinois, Chicago
Tingying Xie, Rutgers Univ, NJ
Martina Yen, Michigan State Univ
Lylybell Y. Zhou, Univ of Florida

A Tribute to Joseph M. Moerschbaecher, III (1949-2021)

Submitted by Wayne Backes, Kurt Varner, Peter Winsauer, and Charles France



We are sorry to announce the death of Dr. Joseph M. Moerschbaecher, III. Joe earned his BS in psychology at Loyola University, Chicago, and PhD in experimental psychology at the American University in Washington, DC. After working as a research associate at the Naval Medical Research Institute, he held postdoctoral and junior faculty positions in pharmacology at Georgetown University Schools of Medicine and Dentistry, and he joined the faculty at Louisiana State University Health Sciences Center – New Orleans in 1983.

Joe rapidly rose through the ranks to full professor, and in 1991 he was selected as Head of the Department of Pharmacology and Experimental Therapeutics at LSUHSC. Through strategic recruiting and mentoring, he built a successful department focused on CNS control of autonomic function, behavioral pharmacology and the pharmacology of drugs of abuse. Joe was an outstanding mentor, who worked with junior faculty both within and outside the department to develop grant and manuscript submissions. He was also available to provide timely and thoughtful advice on a range of issues including teaching, hiring staff and work-life balance. He was truly excited when someone received a grant or special award – in many cases, more excited than the recipient. As a further testament to his mentoring, many of Joe's former mentees and trainees went on to hold leadership positions at LSUHSC and other institutions.

As department head, Joe not only guided the department, but also continued his research career. Joe extensively published in peer-reviewed journals and maintained continuous NIH research support. He was the Co-Founder and Co-Director of the Alcohol and Drug Abuse Center at LSUHC. He also was a frequent participant in NIH study sections and was an award-winning educator.

In 1998, Joe was appointed as Vice Chancellor for Academic Affairs and Dean of the School of Graduate Studies. In this role, he oversaw the expansion of the research enterprise at LSUHSC, the development of the New Orleans Bioinnovation Center, the Louisiana Cancer Research Center, and was Chair of the Louisiana Board of Regents Support Fund Planning Committee. He served in multiple capacities for the American Society for Pharmacology and Experimental Therapeutics and was the President of the Behavioral Pharmacology Society. Joe will always be remembered for his actions in response to Hurricane Katrina. He and his son remained on campus during the storm to take care of the many students living in the dorms who were unable to evacuate. Shortly after the storm passed, it appeared that everyone was safe, and everything would quickly return to normal. Then the water flowed into the city from the broken and breached levees, leading to 6 feet of water surrounding all the buildings of the Health Sciences Center. Realizing that they would be stranded for some time, they went to the cafeteria kitchen, found food that was available, and Joe cooked meals for all the stranded students and staff. He remained there for several days until all were transferred by helicopter to safety.

In the aftermath of the storm, Joe was instrumental in our recovery. He played a major role in the temporary relocation of each of the six schools of the Health Sciences Center to Baton Rouge so that our academic programs could be maintained. During that time, he stayed on a Baltic ferryboat that was brought from Europe to provide housing for the displaced students and faculty who would work and study in Baton Rouge before returning to New Orleans almost a year later.

Joe was both humble and had a great sense of humor. One time, he received a crystal pyramid as an award, and on receipt, he thanked everyone for their support, as well as for the gift of the beautiful di-lithium crystal. Joe did much for ASPET and our scientific community. He will be deeply missed by all who knew him.

"Scientist-Potter": A Tribute to Rebecca Matteson Pruss, PhD

Submitted by John H. Kehne, PhD, Judith A. Siuciak, PhD, Christopher J. Schmidt, PhD and Lisa Schmidt

We are saddened to report the sudden illness and untimely death of Rebecca Matteson Pruss of Cassis, France, at the age of 70. Becky was an accomplished biomedical scientist in the pharmaceutical sector devoted to identifying novel therapeutics, with extensive experience that spanned from early discovery to clinical proof of concept, in small to large pharmaceutical companies.

Becky was born in Minneapolis, Minnesota to parents Bill and Shirley Pruss and grew up in California and Illinois. Instilled with a love of science from her "earliest memory", she excelled academically and was a competitive swimmer in high school. Becky earned her BS in biology from the Illinois Institute of Technology in 1972 and went on to obtain her PhD in biological chemistry from the University of California, Los Angeles in 1977. Her PhD advisor was Harvey Herschman, with whom she produced 9 manuscripts including publications in *Proceedings of the National Academy of Sciences*, *Nature* and *Journal of Biological Chemistry*. From 1978 to 1980, Becky pursued a postdoctoral appointment in neuroimmunology at the University College London, working with Martin Raff. Her research was focused in two primary areas, the first being the development of methods both to culture and identify selective subpopulations of glial cells, e.g., astrocytes, oligodendrocytes, Schwann cells, and ependymal cells. The second area of research was the production and characterization of monoclonal antibodies and isolation of an antibody to pan-specific intermediate filament antigen. Becky also taught neurobiology to undergraduate students. After her London postdoc, she returned to the U.S. to become a Staff Fellow at the National Institutes of Health in Bethesda, Maryland where she worked with Mike Brownstein focusing on monoclonal antibodies to neural antigens, neuropeptide regulation and expression, and second messenger signaling.

In 1986, Becky began a long and successful career in the pharmaceutical industry. Her first position was in Cincinnati, Ohio at the U.S. company Merrell Dow Pharmaceuticals, which through multiple mergers and acquisitions became Hoechst Marion Roussel and eventually Sanofi. Becky subsequently accepted what was intended to be a temporary assignment to the Strasbourg site in France to oversee transfer of technology between the two sites. However, she so enjoyed living in France that she eventually obtained French citizenship and would reside there for the remainder of her life. Over the years, Becky assumed increasing levels of managerial and scientific responsibility, serving first as a Group Leader of Biochemical Pharmacology and then becoming Head of Biomolecular Screening and Enzymology responsible for genomic target identification, selection, expression, assay development, structural biology and high throughput screening. She also served the critical role as liaison with the different therapeutic area discovery research teams. In 1999, Becky was tapped for the role of Head of Exploratory Research and Scientific Director of the Strasbourg Research Center of Sanofi-Synthelabo. This site was responsible for the identification of novel drug targets, high throughput assay development and screening, including whole cell functional and phenotypic screening strategies. These efforts required the assembly and maintenance of compound libraries for high, medium, and low throughput screening as well as protein expression expertise and capacity for structural biology (X-ray crystallography, NMR) and assay development (enzymes, GPCRs).

In 2002, Becky joined the small French biotech company, Trophos, located in Marseilles, France where for 13 years she served as the Chief Scientific Officer working with Chris Henderson, Antoine Beret, and Michel DeLaage. She led the discovery, characterization, and development of novel neuro-

and cyto-protective compounds, secured substantial government and foundation funding, and established and coordinated academic partnerships for translational studies. She oversaw the discovery and development of olesoxime and based on promising clinical results in spinal muscular atrophy, Roche acquired Trophos in 2015. Becky then founded Windover Biomed where she leveraged her expertise to help organizations with translational biomedical research and development. Over the course of her career, Becky contributed to the identification and progression of over a dozen drug candidates and was co-inventor on a number of patents. She authored over 70 scientific articles.

Becky had a great wit and sense of humor and was noted, as one of her friends stated, for her "quiet and unassuming friendship, and her kindness and generosity." She enjoyed cooking and entertaining family and friends from around the world. In recent years, Becky lived an idyllic life on the southern coast of France in the beautiful coastal town of Cassis, her home surrounded by a vineyard. She truly was a Renaissance woman with a wide range of interests in both art and science. An example of her unique combination of creativity, ingenuity and diligence were her efforts in beer making for which she won two awards at the Ohio State Fair (best dark and best light home brew). Perhaps most notable among her many talents were her advanced skills, developed over a lifetime, in creating beautiful ceramic pottery which she displayed in juried exhibitions (https://arcencielpots.wixsite.com/website). Claiming inspiration from one of her ancestors, "a Victorian chemist and inventor who developed steel casting methods using ceramic molds," Becky took great pride in referring to herself as a "scientist-potter," which based on her successes in both realms, is highly deserving and appropriate. Becky is survived by long-time companion, David Edgar, brother Bill Matteson, and his wife Andrea; sister Sandra Gosden and her husband Barry; nephew Kevin, niece Renee, and a host of many friends/former colleagues, all of whom will miss her greatly.

In Sympathy

ASPET notes with sympathy the passing of the following members:

Hyun D. Kim
Joseph M. Moerschbaecher
Rebecca M. Pruss
Thomas R. Tephly

Members in the News

Achievements, Awards, Promotions, and Scientific Breakthroughs

Firas Bazzari

Arab American University

Firas Bazzari, PhD, is Assistant Professor in Pharmacology and Toxicology at the Arab American University. In August of this year, Dr. Bazzari was appointed acting and founding Dean of the Faculty of Pharmacy at the Arab American University.

Dr. Bazzari received his BSc in Pharmacy from Applied Science University, Amman, Jordan, MSc in Clinical Pharmacology from University of Aberdeen, Scotland, UK, and PhD in Pharmacology and Toxicology from the Faculty of Pharmacy at Cairo University, Cairo, Egypt. His research focuses primarily on neurodegenerative and neuropsychiatric disorders and CNS drugs.

Dr. Bazzari has been a member of ASPET since 2017 and is a member of the Division for **Neuropharmacology**.

Share your achievements, awards, and scientific breakthroughs with fellow ASPET members. Send your news to your division's communications officer:

Behavioral Pharmacology
Vanessa Minervini

Cancer Pharmacology
Lori Hazlehurst

Cardiovascular Pharmacology
Rayna Gonzales

Drug Discovery and Development
Alicja Urbaniak

Drug Metabolism and Disposition
Andrew Rowland

Molecular Pharmacology
Marta Sanchez-Soto

Neuropharmacology
Carolyn Fairbanks

Pharmacology Education
Rupa Tuan

Toxicology
Merrie Mosedale

Translational and Clinical Pharmacology
Deborah Luessen

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Division News

Division for Drug Metabolism and Disposition

Sharing Advice to Early Career Researchers: An Interview with Dr. Huichang Bi

Submitted by Lindsay C. Czuba, PhD and Andrew Rowland, PhD

Dr. Huichang 'Nancy' Bi is a principal investigator at School of Pharmaceutical Sciences of Sun Yat-sen University and Southern Medical University. As an early career scientist, Nancy has published over 100 papers, 11 book chapters, and has served as the primary mentor for over 30 graduate students and postdoctoral fellows. At the 2021 ASPET Annual Meeting, Nancy was awarded the Richard Okita Early Career Award in Drug Metabolism and Disposition in recognition of her research excellence and contributions to the field. In this interview, she shares advice to early career researchers and trainees for establishing a productive career, working as a team, and fostering relationships and shares her vision for the future role of metabolomics in science.

You have been very productive early in your career. What general advice do you have for junior scientists who would like to follow in your footsteps?

HB: I am fortunate to have a professional career as a principal investigator at the School of Pharmaceutical Sciences of Sun Yat-sen University and Southern Medical University. Among the most important advice I can give is to find an area of research that you are passionate about and immerse yourself in your chosen field of science. It is vital to keep abreast of the literature, not only in your area of study but also in other diverse areas seemingly unrelated to your core research so that you can transfer technologies to your research and develop ideas. Another key element for success is to develop relationships with senior mentors and collaborators with whom you can share your ideas. I have been fortunate to have many great mentors and collaborators over the years. At each stage of my career, my thinking was influenced significantly by my wonderful mentors and collaborators who had overlapping research interests and encouraged me to take risks that greatly enhanced what I was able to accomplish. Related to this, you should establish communications with other scientists through scientific organizations such as ASPET, which have mentorship and education programs that are of great value to mentors and trainees. Share your work as often as possible with peers, as valuable collaborations may spring from discussions at meetings. Engaging in conversations with scientists from many related disciplines have expanded my horizons and motivated me to become a better scientist. Finally, you should volunteer as a mentor and be active in team activities such as providing tutoring, mentoring, and important leadership advice. You will be teaching, mentoring,

and leading people sooner or later, so practice doing it as much as possible.

What mentoring relationships have you had that prepared you to lead an active research team?

HB: I have been very fortunate to train under the guidance of Prof. Min Huang's and Frank J. Gonzalez's groups early in my career. What I learned through my participation in team activities has been invaluable in developing my mentoring and leading skills. For me, mentorship is more of a collaboration with trainees rather than having a purely supervisory role. This is a process of mutual learning and trust. I have learned a lot from people in my lab and their different viewpoints have been very beneficial in my development as a mentor. At the beginning to establish my research team, I spent considerable time in the lab directly working with my students on their research projects. As my lab group grew, I began to rely on excellent postdoctoral fellows and technicians and senior students who trained and supervised new students to carry out experimental work. My role evolved into largely generating ideas, teaching theory, assisting in data analysis, writing grants, writing and revising manuscripts, and most importantly, encouraging and helping my group members to develop their research programs. I enjoy having a broader role in the career development of my students, postdocs, and staff in my team.

What are the unique challenges with managing a large research group and what advice would you give to lead and manage a research team?

HB: Teams or groups are made up of individuals who have different cultures and abilities and are at different stages of their careers. It's always a challenge to put a new team together and then to develop and expand the team. I have been fortunate to actively participate in the management and administrative activities as the leader of our school, providing the opportunity to develop my management and leadership skills. Early in my career, I faced the challenge of delegating effectively. Successful delegation starts with matching people and tasks, requiring me to understand fully the skills, abilities, experience, characters, and competencies within the team. Also, I needed to learn active listening and the skill of running effective brainstorming lab meetings and one-on-one sessions. As my lab group grew, my key duty and the most important challenges have changed as how to motivate and develop my team members. Motivation can inspire, encourage, and stimulate individuals to achieve great accomplishments. If you can develop team members to become better at what they do, you will soon become someone that others want to work for.

Your research often involves metabolomics and metabolomic techniques. How do you think this has shaped your research focus and what roles do you envision it will have in pharmacology research 10 years from now?

HB: The availability of –omics have greatly advanced the field of pharmacology including the DMPK areas. Metabolomics is a very important tool that allows us to address a multitude of pharmacological questions in the black box. Metabolomics is useful to generate data that yields a more complete understanding of metabolites and metabolism of xenobiotics and endobiotics in biological systems, and then to decipher the complex regulatory mechanisms involved in disease processes, drug-disease interactions, the optimization of drug treatment, the improvement of drug efficacy and safety, and even the identification of novel drug targets. Soon, metabolomics methods will likely become more "kit" oriented, the instruments will become simpler and cheaper, and informatics resources and methods will be developed to robustly and rapidly interrogate huge terabytes of –omics data. I imagine a future where important advances in many key metabolomics technologies and methods can continue to promote our understanding in disease, diagnosis, therapy, drug discovery and development, and can bring to precision medicine through the multitude of applications in pharmacogenomics, pharmacometabolomics and pharmacomicrobiomics.

Division for Toxicology

Talking Tox: An Interview with Dr. Merrie Mosedale

Submitted by Kalina Rivera & Brendan D. Stamper, PhD

Merrie Mosedale received her PhD in biomedical sciences (molecular pharmacology) from the University of California, San Diego and conducted postdoctoral research at the Hammer Institutes for Health Sciences. Since establishing her own research program at the UNC Eshelman School of Pharmacy, Dr. Mosedale has pioneered the use of the Collaborative Cross mouse genetic reference population to identify risk factors and mechanisms associated with drug-induced liver injury (DILI) in humans. She was also the first to demonstrate that hepatocyte-derived exosome number and content changes in response to idiosyncratic DILI drugs prior to overt necrosis and suggest this contributes to an adaptive immune attack. Dr. Mosedale's work has led to a greater understanding of the pathogenesis of idiosyncratic DILI as well as several nonclinical approaches that may allow for the accurate prediction of DILI liability for new chemical entities. ASPET's Division for Toxicology would like to thank Dr. Mosedale for taking the time to sit down and share some of her thoughts with us for this article.

What drew you into the field of pharmacogenomics and why?

MM: I ended up in the field of pharmacogenomics in a roundabout way. I had a longstanding interest in the area of genomics, however, my PhD work was more in disease-based research. When I was looking for post-doc opportunities, I certainly wanted to apply some of the skills and knowledge that I had gained from my PhD, but I wanted to do so in a more applied way, so I was interested in getting into the area of pharmaceutical research in some capacity. I found a postdoc opportunity where I could take some of my skills, experience, and expertise in the area of molecular biology and pharmacology and my interest in genomics and apply it to pharmaceutical safety research. I ended up in the field in that way. I did fall very much in love with it as a result of that experience and have been able to work in that space ever since.

How has pharmacogenomics impacted toxicology during your career?

MM: I haven't been in an investigator position for that long so there hasn't been a ton of time for pharmacogenomics to have a major impact on the field of toxicology during my career so far. However, I can say that there has been a greater appreciation, in the past 20 years or so, that genetics plays a role in drug response. It is most appreciated in pharmacokinetics and pharmacodynamics. Pharmacogenetic information is now on the labeling of hundreds of FDA-approved drugs. Variants that affect the pharmacokinetics and pharmacodynamics of a drug certainly can have an impact on drug response more in the toxicology space. I wouldn't say that the knowledge of that has changed how people do toxicology research so much at this stage, which is unfortunate because we know it plays a role. However, I think there is more of an appreciation of the impact of genetic variation on adverse drug response. That is what a lot of my work is trying to do by developing tools and approaches that can be more readily applied towards understanding the impact of genetic variation on adverse drug response. At a greater level, understanding what population responses might look like at concentrations that might cause an adverse response when you're

thinking about appropriate doses in human studies. To take it one step further, we can identify genetic loci in individual genes and variants that contribute to toxicities. The hope is that we can make changes in that space and, in the not too distant future, to make sure that it is better addressed in the drug development process.

In your opinion, what is the biggest impact your Translational Pharmacogenomics Research Program has had in shaping the future of toxicology?

MM: I'm not sure we've had the biggest impact yet, but I hope my program will eventually enable investigators to incorporate genetic diversity into preclinical studies and be able to evaluate the impact of genetics on adverse drug response in a much more efficient, cost-effective way. My group and several other groups have been instrumental in showing that genetically diverse mouse populations can serve as good models to study adverse drug responses in human populations.

When you do an in vivo mouse population study, you're typically working with 50 different mouse strains. Within each strain, you're going to have a vehicle and drug treatment with animals and have multiple replicates of each treatment group. That's just looking at a single dose and duration of exposure. To do a large population study with just a single dose and duration of exposure, you're looking at 400 animals. That is a lot of animals! It's an expensive and time-consuming study. It's not something that most pharmaceutical companies or anybody in the early stages of the drug development process would want to incorporate into a toxicity testing strategy.

My lab is trying to develop an in vitro version of the mouse population-based approach. We isolate primary cells from the different strains that make up the population, then culture them as 3D spheroids on multi-well plates so that you can do multiple treatments, endpoints, replicates, and concentrations all within a single experiment. You can do hundreds of these with cells isolated from a single mouse. When you take it to an in vitro platform, it becomes much more acceptable in terms of cost, time, and information that is provided from the approach. We think that it is going to be a more rapid, cost-effective way to look at gene-by-treatment interactions that contribute to adverse drug response. We hope to make it so that investigators can use this approach at any stage of drug development including drug discovery. There are certainly a lot of advantages when working with in vitro systems such as higher throughput, content, and power. I think that's where a lot of early drug discovery and development work is going. The hope is that by employing a population-based approach early in drug development that you will screen out toxicities that are typically only identified once you get into the large-scale clinical studies. They will require a specific genetic background that you may not see in all individuals in a clinical trial so you may only see it in 1 in 100 or 1 in 1000. Until you get into phase 2 or 3, you're not going to observe these kinds of toxicities. If we can include population variability early, then we will hopefully be able to screen out compounds that might have those rare, genetically driven toxicities in the drug development process. That would certainly prevent compounds that are not going to succeed from getting further along in the development process. Hopefully, this will help companies prioritize lead candidates that are more likely to succeed and get into the clinic.

What has been the biggest obstacle your research program has faced this far in your career?

MM: The challenge is convincing people how the mouse population-based approach, even if it's not exactly what is happening in humans, can still have utility in terms of guiding human investigation. When considering an in vitro setting, most people gravitate toward using human cells. There certainly are species differences particularly in aspects of cell biology that are relevant to drug metabolism, disposition, and pharmacodynamics. However, the distribution of genetic diversity that we get from the mouse population would be difficult to replicate in human cells. I hope that advances in the field allow us to engineer human cells and cell lines to have as much diversity and a distribution of diversity similar to what exists in the mouse populations. However, there is no human system that offers the same genetic advantages as the mouse population-based approach currently, so you have to try and convince reviewers and collaborators that there is utility in a mouse population-based approach knowing the differences in mice and humans when it comes to pharmacokinetics and pharmacodynamics.

To overcome that,we explain how we look for variation in a mouse system, knowing the specific

variants and genes that influence a response in mice are not necessarily going to be the same ones that influence a response in humans. From a screening standpoint, the variations can help us to appreciate where there is going to be population variability in response. They can also drive hypothesis-driven interrogation of human data.

What advice would you give yourself in the past knowing what you know now?

MM: Don't be scared of bioinformatics! If you come from a cell biology/biochemistry/molecular biology background and you're comfortable in that space, a bioinformatics aspect of genomics can be intimidating. However, it is a very important knowledge set to have to be successful in the genomics field. It's important to be comfortable working with large data sets, the same types of software, and computational approaches that are needed to do genomics research. You'll never have an opportunity where you get the time, freedom, and flexibility to train in things that may not be directly applicable to the work that you do in a PhD program or postdoc so take advantage of that time to build your skill set in all these areas that may not be super important at the time but probably will be long term. I think this is where the field is moving. Folks that have that kind of skill set and aren't scared of bioinformatics are going to be very successful in this field. You don't have to be an expert in bioinformatics! As long as you aren't intimidated and can get some familiarity with the areas, it will be extremely valuable.

As a teacher, mentor, and researcher, how has ASPET contributed to your career?

MM: I've had a longstanding relationship with ASPET. I've been a member for almost 15 years. It was the first professional scientific organization I joined as a PhD student. As a student, it created a platform to connect with other students and more senior folks in the field. The experience of going to big conferences, exchanging information, and networking was really valuable. As a postdoc, I successfully applied for an ASPET fellowship that helped fund a year of my postdoc to work using mouse population models to look at adverse drug response. As a trainee, they helped fund some of my work so that was extremely valuable. As a teacher and mentor, ASPET is a good resource and platform for my students to get exposed to the broader scientific community. As a researcher, the funding has been most impactful. They provide a great community to interact with others in the field, exchange ideas, get guidance, make connections and collaborate with others. They provide us with valuable resources to stay up to date with the most current research in the field as well as allow us to publish our own work. This is a really valuable organization!

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Chapter News

Summer Greetings from the CSPT

The past few months have been highly active for Canadian Society of Pharmacology and Therapeutics (CSPT). We concluded our Scientific Meeting in early June and in July had a transition to new leadership with Dr. Bruce Carleton (University of British Columbia) taking over as CSPT President from Dr. Kerry Goralski (Dalhousie University). The incoming leadership is in the process of developing their plans for the coming years, and we aim to have an update in the near future.

2021-2022 CSPT Leadership

President	Bruce Carleton (University of British Columbia)
Immediate Past President	Kerry Goralski (Dalhousie University)
President-Elect	Bradley Urquhart (University of Western Ontario)
Treasurer	Donald Miller (University of Manitoba)
Director-at-Large and RCPSC Liaison	Doreen Matsui (University of Western Ontario)
Awards Committee Chair	Abby Collier (University of British Columbia)
Education Committee Chair	Fabiana Crowley (University of Western Ontario)
Publication Committee Chair	Dylan Burger (Ottawa Hospital Research Institute)
Scientific Program Committee Chair	Michael Rieder (University of Western Ontario)
Outreach Committee Chair	Bruce Carleton (University of British Columbia)
ASPET Liaison	Kerry Goralski (Dalhousie University)
COVID-19 Committee Chair	Antonios Diab (Dalhousie University)
Nominations Committee Chair	Kerry Goralski (Dalhousie University)

Report on the 2021 Scientific Meeting

The 2021 Scientific Meeting of the Canadian Society of Pharmacology and Therapeutics: “Not on Mute: Let’s Talk Contemporary Pharmacology” was held from June 7-11, 2021. For the second straight year the meeting was held virtually due to COVID restrictions; however, the meeting was greatly expanded compared to 2020 with a sleek virtual interface, networking activities and events, and a strong program featuring keynote speakers.

The meeting opened with presentation of the 2021 awards and award lectures. A list of awardees can be found below. Dr. Abby Collier, Chair of the CSPT Awards Committee, noted the diversity of the recipients: “Awardees were male and female. Four of six awardees are considered traditionally under-represented communities (women in STEM (1), visible minorities (3))”.

Day two focused on the much-anticipated “High Cost Drugs in Pediatrics Summit,” a first of its kind gathering of stakeholders to discuss the challenge of high cost drugs in pediatric medicine and to discuss collaborative strategies to ensure equitable access to therapies. The summit attendees included clinicians, discovery scientists, as well as representatives from government agencies, NGOs, and patient advisory groups. Stay tuned for updates on future activities extending from the high cost drugs summit.

Day three opened with a plenary session on membrane proteins with a keynote lecture from Dr. Stephen Ferguson (University of Ottawa), “Regulation of Metabotropic Glutamate Receptor Signaling: Role

in Alzheimer's and Huntington's Diseases," followed by a highly active COVID-19 symposium in the afternoon. The day concluded with a Kahoot trivia networking event that was won by Dr. Goralski.

Day four was trainee-focused, opening with the Top 10 Trainee Oral Presentations followed by an afternoon "Practical Pharmacology" session and an evening Career Networking event.

The meeting closed with a plenary session on cancer pharmacology with a keynote lecture by Dr. Lilian Siu (University of Toronto), "Clinical Applications of Liquid Biopsies for Monitoring of Disease and Response to Therapy," and a pharmacology education workshop, "Course Design with Students in Mind – Encouraging Learner Success in Pharmacology."

In total the meeting had 179 attendees and almost 50 virtual posters. Feedback from the event has been overwhelmingly positive. Attendees were engaged immediately through the platform's icebreaking tools, and the community remained active throughout the meeting. CSPT immediate past president Kerry Goralski noted that "[t]he Program Chair Thomas Velenosi (University of British Columbia) and his committee can be proud of the tremendous success of the 2021 CSPT Scientific meeting. The virtual platform was easy to navigate, there were many opportunities to socialize and network and the trainee presentations and pharmacology programming was outstanding. The mics were on and the science spoke. See you at CSPT 2022!"

2021 CSPT Award Winners

Distinguished Service and Education Award
Kerry Goralski (Dalhousie University)

Senior Investigator Award
Anna Taddio (University of Toronto)

Junior Investigator Award
Rithwik Ramachandran (Western University)

Postdoctoral Fellowship Award
Qutuba Karwi (University of Alberta)

Clinical Fellowship Award
Marc Chretien (Western University)

Publication Award
Khaled Abdelrahman (University of Ottawa)

2021 Trainee Awardees

Rhoderic Reiffenstein Award
Brendan McKeown (Dalhousie University)

Peter Dresel Award
Yongjin (James) Lin (Western University)

Ken Piafsky Award
Brent Tschirhart (Western University)

William Mahon Award
Kristen Meyer (University of Toronto)

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New virtual sessions are planned throughout the year.

View the schedule and learn more at **www.aspet.org/focus**.

Check out past recorded sessions on the ASPET Focus on Pharmacology community on ASPET*Connect*.

The Focus on Pharmacology virtual series is free for all ASPET members. Not a member yet? Sign up for membership at www.aspet.org/membership.