The 29th Science in Japan Forum

CHEM-BIO NEXUS: TRANSFORMING FOOD AND HEALTH

THURSDAY
18 JUNE
TH, 2026
PM1:00~6:30 (EST)

Format: Onsite only
Venue: Cosmos Club

This event is by invitation only.

NAGOYA UNIVERSITY
U.S. DEPARTMENT OF ENERGY | Office of Science
EMBASSY OF JAPAN WASHINGTON, D.C.
AAAS
Alumni Association JSPS
JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE FOUNDED 1932

The Twenty-Ninth

"Science in Japan" Forum

Chem-Bio Nexus: Transforming Food and Health

Cosmos Club
Washington, DC
June 18, 2026

Sponsored by
Japan Society for the Promotion of Science

Co-sponsored by
AAAS (American Association for the Advancement of Science)
DOE (Department of Energy)
Embassy of Japan in the United States of America
Institute of Transformative Bio-Molecules (WPI-ITbM)
Nagoya University
NC State University
North America JSPS Alumni Association
University of Toronto

Agenda

12:00 pm - Registration

1:00 pm - 1:20 pm

Opening Remarks

Ambassador Takehiro Shimada, Deputy Chief of Mission, Embassy of Japan in the United States of America

Dr. Rita Colwell, Distinguished University Professor, University of Maryland

Dr. Kimberly Montgomery, Director, International Affairs and Science Diplomacy, American Association for the Advancement of Science

Dr. Corey Cohn, Senior Advisor for International Engagement, Office of Science, U.S. Department of Energy

1:20 pm - 2:10 pm

Session 1: The hidden mysteries of biological rhythms: insights from chemical genomics

Professor Takashi Yoshimura, Director/Professor, Institute of Transformative Bio-Molecules (WPI-ITbM), Nagoya University

2:10 pm – 2:50 pm

Session 2: Molecular Biomimicry: Chemistry Meets Biology to Address Health

Professor Joshua Pierce, Howard J. Schaeffer Distinguished Professor of Chemistry, Executive Director, Integrative Sciences Initiative, NC State University

2:50 pm – 3:10 pm Coffee Break

3:10 pm – 3:50 pm

Session 3: Molecular insights into stomatal opening: Improving plant performance through chemical and genetic control

Professor Toshinori Kinoshita, Professor, Institute of Transformative Bio-Molecules (WPI-ITbM), Nagoya University

*Time Zone: Eastern Daylight Time

3:50 pm – 4:30 pm

Session 4: Expanding Druggable Space: Small Molecule Modulation of RNA Structure and Function

Professor Amanda Hargrove, Professor of Chemistry, Director, Centre for Medicinal Chemistry, University of Toronto

4:30 pm – 4:50 pm Coffee Break

4:50 pm – 5:00 pm

Introduction to the Panel Discussion: Mechanistic Enzymology of Nonheme Iron Catalysts in Natural Product Biosynthesis

Professor Wei-chen Chang, Professor of Chemistry, Department of Chemistry, NC State University

5:00 pm – 6:00 pm

Panel Discussion

Moderator:

Professor Wei-chen Chang, Professor of Chemistry, Department of Chemistry, NC State University

+ All Speakers

6:00 pm –

Closing Remarks

Director Tomohisa Koyama, Executive Director, Technology Partnership of Nagoya University, Inc.

Dr. Kazushi Okada, Director for Technology Transfer, Technology Partnership of Nagoya University, Inc.

6:30 pm –

Reception

*Time Zone: Eastern Daylight Time

<For All Participants>

- JSPS will take some photographs and video recordings during the forum. They may be used for the website and other publications by host organizations.
- Please do not take pictures or videos.
- There will be Q&A after each talk. If you have questions, please come to the mic stand.

Foreword

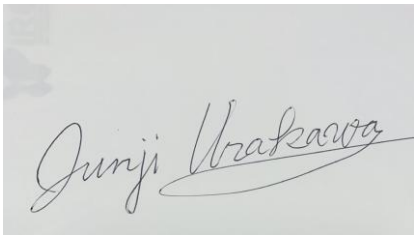
The “Science-in-Japan” Forum, started in 1996, is held annually in Washington, D.C., by Dr. Masatoshi Koshiba, the Director of the Japan Society for the Promotion of Science (JSPS) Washington Office (WO), to promote scientific cooperation between Japan and the United States.

The theme of the 29th forum, to be held in June 2026, is **“Chem-Bio Nexus: Transforming Food and Health.”** This forum will showcase the latest research and development initiatives from leading institutes such as the Institute of Transformative Bio-Molecules (WPI-ITbM) at Nagoya University in Japan, the Centre for Medicinal Chemistry at University of Toronto in Canada, and the Integrative Sciences Initiative at North Carolina State University in the USA.

These institutes share a common vision: to create **transformative bio-molecules** with the potential to reshape food systems, human health by forging dynamic collaborations at the intersection of chemistry and biology, they are trying to pioneer new scientific paradigms that transcend traditional disciplinary boundaries. This forum will provide a platform to showcase these advances, encourage cross-disciplinary discussion, and explore how Chem-Bio collaboration can drive sustainable, impactful solutions for the future.

This forum is co-sponsored by AAAS (American Association for the Advancement of Science), DOE (U.S. Department of Energy), Nagoya University, WPI-ITbM, University of Toronto, North Carolina State University, and the JSPS North America Alumni Association (AA). I want to express our sincere gratitude to the staff of the JSPS Washington Office for their efficient preparation of this forum.

I hope all the participants will find the Forum valuable and enjoyable.



Junji Urakawa
Director, JSPS Washington Office

The hidden mysteries of biological rhythms: insights from chemical genomics

Takashi Yoshimura
Director/Professor, Institute of Transformative Bio-Molecules (WPI-ITbM),
Nagoya University
PhD in Agriculture

The celestial motions of the Sun, Earth, and Moon cause cyclic changes in the environment. The spawning of corals and sea turtles is synchronized with the lunar cycles. In addition, the reproduction, migration, and hibernation of various animals occur during specific seasons. As described in Aristotle's "Historia Animalium," humans have been fascinated by these mysterious biological activities since ancient times. Interestingly, humans are no exception, with the synchronization of the menstrual cycle with new and full moons. In addition, in winter, cardiovascular disease, influenza, and depression are more severe and mortality rates markedly increase. However, the underlying mechanisms remain unknown.

Although traditional model animals such as Drosophila and mouse are undoubtedly good models for understanding various aspects of physiology and behavior, they do not show clear phenotypes. With the use of non-model organisms, we have uncovered previously unknown signal transduction pathway that regulates seasonal rhythms.

The Institute of Transformative Bio-Molecules (ITbM), a member of the World Premier International Research Center Initiative (WPI), aims to create a new interdisciplinary research field through the collaboration of synthetic chemistry, animal/plant biology, and theoretical science. Using a chemical genomics approach, we uncovered mechanisms underlying winter depression-like behavior in medaka fish. To further understand the molecular basis of seasonally regulated physiology and diseases, we analyzed seasonal transcriptomes of 80 macaque tissues and established the web database ‘Non-Human Primate Seasonal Transcriptome Atlas’ (NHPSTA). Analyses of NHPSTA demonstrated seasonal oscillations in the expression of disease risk factor genes and drug efficacy. We also identified the pheromone involved in the mechanism that triggers puffer fish to spawn on beaches during the spring tide.

In this talk, I will provide an overview of ITbM and present our efforts to unravel the mysteries of biological rhythms.

Present

Director/Professor, Institute of Transformative Bio-Molecules, Nagoya University
Professor, Graduate School of Bioagricultural Sciences, Nagoya University

Education

1989 - 1993 Undergraduate Student in the Faculty of Agriculture,
Nagoya University, Obtained B.Agr.
1993 - 1996 Graduate Student in the Graduate School of Agriculture,
Nagoya University, Obtained Ph.D. (Thesis advisor; Dr. Shizufumi Ebihara)

Academic Career

1996 - 2005 Assistant Professor at School of Agriculture,
Nagoya University
2005 - 2008 Associate Professor at Graduate School of Bioagricultural Sciences,
Nagoya University
2008 - present Professor at Graduate School of Bioagricultural Sciences,
Nagoya University
2013 - 2019 Visiting Professor at National Institute for Basic Biology
2019 - present Professor at Institute of Transformative Bio-Molecules (WPI-ITbM),
Nagoya University
2022 - present Director at Institute of Transformative Bio-Molecules (WPI-ITbM),
Nagoya University

Academic awards

2009 JSPS Prize (Tokyo, Japan)
2009 Japanese Society of Animal Science Award (Tokyo, Japan)
2010 Hoffenberg International Medal (Society for Endocrinology, UK)
2011 Fellow (Royal Society for Biology, UK)
2015 Van Meter Award (American Thyroid Association, USA)
2019 Axelrod Lectureship Award (European Biological Rhythms Society, France)
2020 Aschoff and Honma Prize for Biological Rhythm Research (Sapporo, Japan)
2021 Kihara Memorial Foundation Academic Award (Yokohama, Japan)
2024 Aschoff's Rule Prize (Society for Research on Biological Rhythms, USA)
2025 Chunichi Cultural Award (Nagoya, Japan)
2026 Naito Foundation Merit Award (Tokyo, Japan)

Molecular Biomimicry: Chemistry Meets Biology to Address Health

Joshua G. Pierce
Howard J. Schaeffer Distinguished Professor of Chemistry, NC State University
Executive Director, Integrative Sciences Initiative, NC State University
PhD in Chemistry

Nature has evolved an extraordinary array of complex molecules, i.e., natural products, that execute precise biological functions with remarkable specificity and potency. From antibiotics that disrupt bacterial cell wall biosynthesis to antitumor agents that modulate cellular signaling, these biomolecules represent the product of millions of years of evolutionary refinement. Molecular biomimicry, the strategy of using synthetic organic chemistry to recreate, study, and redesign these natural architectures, offers a powerful platform for advancing both our fundamental understanding of biology and our capacity to address human disease.

The Pierce laboratory at NC State University develops new synthetic methods to access structurally complex natural products and their designed analogs. By engineering targeted chemical modifications at defined positions within these scaffolds, we can interrogate the molecular determinants of biological activity with exceptional precision. This chemistry-forward approach to chemical biology enables us to identify the pharmacophoric elements responsible for target engagement, information essential for rational therapeutic development. These efforts interface with robust biological studies in our own lab and in collaborators' labs.

In parallel, I will highlight the Integrative Sciences Initiative at NC State University, a university-level effort designed to catalyze interdisciplinary discovery at the molecular scale. Anchored in Woodson Hall, ISI brings together expertise across chemistry, biology, physics, engineering, and data science to address fundamental challenges in human health, agriculture, and biotechnology. Central to this effort are integrated research accelerators that leverage automation, advanced imaging, and high-throughput molecular analysis to enable faster, more predictive discovery. By integrating cutting-edge research infrastructure with innovative, workforce-aligned education, ISI is building a new model for conducting, teaching, and translating molecular science into real-world impact.

In this lecture, I will present an overview of our laboratory's efforts to employ molecular biomimicry as a strategy for chemical probe development and drug discovery, centered around our fascination with marine natural products. I will also provide an overview of the Integrative Sciences Initiative and our bold efforts to drive forward molecular discovery.

Present

Howard J. Schaeffer Distinguished Professor of Chemistry, NC State University
Executive Director, Integrative Sciences Initiative, NC State University

Education

1999 - 2003 Undergraduate Student in the Department of Chemistry,
University of Pittsburgh, Obtained B.S.
2003 - 2008 Graduate Student in the Department of Chemistry,
University of Pittsburgh, Obtained Ph.D. (Thesis advisor; Dr. P. Wipf)

Academic Career

2008 - 2012 Postdoctoral Fellow at The Scripps Research Institute,
La Jolla, CA (Dr. D.L. Boger's laboratory)
2012 - 2018 Assistant Professor at the Department of Chemistry,
NC State University
2018 - 2022 Associate Professor at the Department of Chemistry,
NC State University
2022 - present Howard J. Schaeffer Distinguished Professor of Chemistry,
NC State University

Academic awards

2015 NSF CAREER Award (Raleigh, NC, USA)
2017 Chancellor's Innovation Fund Award, NC State University
2018 University Faculty Scholar, NC State University
2019 Sigma Xi Faculty Research Award, NC State University
2020 Howard J. Schaeffer Distinguished Professorship, NC State University

Molecular insights into stomatal opening: Improving plant performance through chemical and genetic control

Toshinori Kinoshita
Professor, Institute of Transformative Bio-Molecules (WPI-ITbM),
Nagoya University
PhD in Science

Stomata are microscopic pores on the plant surface that regulate gas exchange, balancing CO_2 uptake for photosynthesis with water loss through transpiration. Because of this central role, stomatal function directly influences plant growth, crop yield, and drought tolerance—key factors for global food security. Over the past two decades, molecular studies have revealed the signaling networks that control stomatal opening, particularly in response to light. These include blue-light receptors, protein kinases, and plasma membrane (PM) H^+-ATPases that coordinate ion transport and guard cell turgor. Such mechanistic insights have provided a foundation for rational manipulation of stomatal aperture.

Based on these findings, we have developed strategies to artificially control stomatal aperture. Genetic approaches, including the overexpression of PM H^+-ATPase in guard cells, demonstrate that enhanced stomatal opening can promote plant growth and increase crop yield under optimal conditions. These results highlight the potential of stomatal engineering as a powerful route to improve plant productivity. In parallel, we have established a chemical biology approach to understand molecular mechanisms of stomatal movements and to modulate stomatal function. We have identified small molecules that either inhibit or promote stomatal opening. Compounds that suppress stomatal opening reduce water loss and confer drought tolerance, whereas compounds that promote opening enhance photosynthetic activity and plant growth. Unlike genetic modification, chemical regulation offers a flexible and potentially deployable strategy for controlling plant physiology in diverse environments.

Together, these studies illustrate how integrating chemistry and biology enables the reprogramming of stomatal function across multiple scales—from molecular mechanisms to whole-plant performance. This ChemBio-based framework provides new opportunities to develop sustainable and impactful solutions for agriculture and food systems.

Present

Professor, Institute of Transformative Bio-Molecules, Nagoya University
Professor, Graduate School of Science, Nagoya University

Education

1987 - 1991 Undergraduate Student in the Faculty of Science,
Kyushu University, Obtained B.Sc.
1991 - 1993 Graduate Student in the Graduate School of Science,
Kyushu University, Obtained Ph.D. in 1997 (Thesis advisor; Dr. Ken-ichiro Shimazaki)

Academic Career

1994 - 1999 Research Associate at Graduate School of Science,
Kyushu University (Dr. Shimazaki's laboratory)
1999 - 2007 Assistant Professor at Graduate School of Science,
Kyushu University
2003 - 2004 Visiting Scientist at Salk Institute (Dr. Joanne Chory's lab)
2007 - 2010 Associate Professor at Graduate School of Science,
Nagoya University
2010 - present Professor at Graduate School of Science,
Nagoya University
2013 - 2024 Director at Center for Gene Research,
Nagoya University
2013 - present Professor at Institute of Transformative Bio-Molecules (WPI-ITbM),
Nagoya University

Academic awards

1998 Inoue Foundation Award for Young Scientist (Tokyo, Japan)
2003 The Japan Society of Plant Physiology Award for Young Scientist (Kyoto, Japan)
2007 Minister Award for Distinguished Young Scientists (Tokyo, Japan)
2015 The Botanical Society of Japan, Journal of Plant Research, Best Paper Award (Tokyo, Japan)
2024 6th The Photobiology Association of Japan Award (Kyoto, Japan)
2023 - 2025 Highly Cited Researcher, Clarivate (London, UK)

Expanding Druggable Space: Small Molecule Modulation of RNA Structure and Function

Amanda Hargrove
Professor of Chemistry, Department of Chemical and Physical Sciences, University of Toronto
Director, Centre for Medicinal Chemistry, University of Toronto (Mississauga)
PhD in Organic Chemistry

While recent advancements in drug discovery have enabled increasingly personalized medicines, over 90% of approved drugs target proteins, one of many classes of biomolecules. Furthermore, only about 1/3 of disease-related proteins have been successfully drugged, highlighting a substantial gap in treating human disease. RNA offers an attractive alternative as it plays essential roles in protein synthesis and can also function independently to drive disease. However, due to fundamental differences in chemistry and structure between proteins and RNA, RNA-targeted drugs represent less than 2% of approved therapeutics. While oligonucleotide drugs (i.e. siRNAs) have been successful in a select number of cases, drugs based on organic small molecule drugs offer significant advantages in delivery and oral availability.

The Hargrove Lab works to expand the druggable landscape by elucidating how small molecules can be designed to selectively modulate disease-related RNAs. By integrating organic synthesis, machine learning, and a range of biophysical and cellular assays, we have identified patterns in the properties of bioactive RNA ligands as well as in RNA architectures that allow selective interactions. In this lecture, I will discuss the application of these fundamental discoveries to target disease-related RNA in biological systems, including cancer-driving noncoding RNAs (e.g., prostate, lung cancer) and viral regulatory RNAs (e.g., enterovirus, SARS-CoV-2, dengue).

I will also highlight the Centre for Medicinal Chemistry (CMC) at the University of Toronto, which brings together researchers across multiple disciplines to advance small molecule drug discovery. The CMC leverages expertise in target identification, screening, organic synthesis, biophysical and cellular approaches to target engagement, and animal models to tackle challenging targets such as RNA. Through these collaborative efforts, we aim to translate fundamental discoveries into new therapeutic strategies while training the next generation of scientists in modern medicinal chemistry.

Present

Director, Centre for Medicinal Chemistry, University of Toronto Mississauga

Professor of Chemistry, Department of Chemical and Physical Sciences, University of Toronto

Education

2000 - 2004 B.S., Chemistry and Spanish, Trinity University, San Antonio, Texas, USA

2004 - 2010 Ph.D., Organic Chemistry, University of Texas at Austin; Austin, Texas, USA (Research Advisors: Professors Eric V. Anslyn and Jonathan L. Sessler)

Academic Career

2010 - 2013 NIH NRSA Postdoctoral Fellow, California Institute of Technology
2013 - 2020 Assistant Professor of Chemistry, Duke University
2015 - 2020 Assistant Professor of Biochemistry, Duke University
2020 - 2023 Associate Professor of Chemistry, Duke University
2020 - 2024 Associate Professor of Biochemistry, Duke University
2023 - 2024 Professor of Chemistry, Duke University
2024 - 2025 Research Professor of Chemistry, Duke University
2024 - Professor of Chemistry, University of Toronto
2025 - Director, Centre for Medicinal Chemistry, University of Toronto (Mississauga)

Academic awards

2010 - 2011 Tobacco-Related Disease Research Program Postdoctoral Fellowship
2011 - 2013 NIH Ruth L. Kirschstein National Research Service Award Postdoctoral Fellowship
2014 Ralph E. Powe Junior Faculty Enhancement Award
2015 Prostate Cancer Foundation Young Investigator Award
2017 Research Corporation for Science Advancement Cottrell Scholar Award
2018 NSF CAREER Award
2018 ChemComm Emerging Investigator Lectureship
2019 RSC Medicinal Chemistry Emerging Investigator Lectureship
2020 Dean's Diversity Award, Trinity College of Arts and Sciences, Duke University
2020 Sloan Research Fellowship
2021 Langford Lectureship, Duke University
2021 Cram Lehn Pedersen Prize in Supramolecular Chemistry
2021 American Chemical Society Women Chemists Committee Rising Star Award
2023 RNA Society Elisa Izaurralde Award for Innovation in Research, Teaching, and Service
2024 Canada Research Chair in RNA Targeted Drug Discovery

Mechanistic Enzymology of Nonheme Iron Catalysts in Natural Product Biosynthesis

Wei-chen Chang
Professor of Chemistry, Department of Chemistry, North Carolina State University
Ph.D. in Medicinal Chemistry

The Chang laboratory investigates how nonheme iron enzymes catalyze chemically challenging transformations in natural product biosynthesis. By combining mechanistic enzymology, spectroscopy, computation, and synthetic chemistry, this research seeks to uncover how metalloenzymes control selective bond activation and direct diverse reaction outcomes. Particular emphasis is placed on understanding the formation of unusual functional groups and scaffolds, including cyclopropanes, aziridines, nitriles, isonitriles, and halogenated products, as well as oxidative carbon–carbon and carbon–nitrogen bond-forming reactions. These studies reveal the molecular principles by which iron-dependent enzymes harness high-energy intermediates to achieve precise and versatile catalysis.

This work advances fundamental knowledge of enzyme mechanism while creating opportunities to expand the synthetic utility of biosynthetic catalysts. Through studies of nonheme iron enzymes involved in pharmacophore assembly and natural product diversification, the laboratory has established new frameworks for understanding and reprogramming enzymatic reactivity. Supported by NIH and NSF funding, this research bridges organic chemistry, bioinorganic chemistry, and chemical biology, illustrating how mechanistic insight can drive biosynthetic innovation and inspire new strategies for selective molecular construction.

Present

Professor of Chemistry, Department of Chemistry, North Carolina State University

Education

1999 - 2003 Undergraduate Student in the Department of Agricultural Chemistry, National Taiwan University, Obtained B.S.

2005 - 2011 Graduate Student in the Division of Medicinal Chemistry, College of Pharmacy, The University of Texas at Austin, Obtained Ph.D.

2011 - 2014 Postdoctoral Research in the Department of Chemistry, The Pennsylvania State University

Academic Career

2016 - 2021 Assistant Professor at the Department of Chemistry, North Carolina State University

2021 - 2025 Associate Professor at the Department of Chemistry, North Carolina State University

2025 - present Professor at the Department of Chemistry, North Carolina State University

Academic awards

2015 Founders Award for the 2015 Enzyme Mechanisms Conference

2016 Faculty Research and Professional Development Program Award, North Carolina State University

2019 Faculty Early Career Development Program (CAREER) Award, National Science Foundation

2020 ACS Academic Young Investigator, Division of Organic Chemistry

2022 Goodnight Early Career Innovator, North Carolina State University

2023 LORD Corporation Distinguished Scholar, North Carolina State University

2025 University Faculty Scholar, North Carolina State University

NOTES

NOTES

JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE
日本学術振興会

Founded in 1932 with an endowment of Emperor Showa,
the Japan Society for the Promotion of Science (JSPS) is Japan's core independent funding agency.
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