2022 DICKSON PRIZE DAY
Tuesday, July 19, 2022
University Club, Ballroom B

8:00 A.M. **Registration**

9:00 A.M. **Welcome Remarks**
Patrick D. Gallagher, PhD
Anantha Shekhar, MD, PhD

9:20 A.M. **Conferring of Dickson Prize Medals to Drs. Bertozzi (2022 honoree), Kenyon (2021 honoree) and Collins (2020 honoree)**
Patrick D. Gallagher, PhD
Anantha Shekhar, MD, PhD

9:30 A.M. **2022 Dickson Prize in Medicine Lecture**
Therapeutic Opportunities in Glycoscience

Carolyn Bertozzi, PhD
Baker Family Director of Stanford Chemistry, Engineering, and Medicine for Human Health
Anne T. and Robert M. Bass Professor, School of Humanities and Sciences
Professor, by courtesy, of Chemical and Systems Biology and of Radiology
Stanford University

10:30 A.M. **Break**

10:45 A.M. **Session 1: The Chemistry-Biology Interface in Human Health and Disease**

Moderator: Ora Weisz, PhD

Deep Dive into the Tuberculosis Granuloma
JoAnne L. Flynn, PhD

Synthesizing Covalent Inhibitors with Predictable Thiol Reactivity
Kay Brummond, PhD

Novel Pathways and Strategies for Development of Oncologic Therapies at the UPMC Hillman Cancer Center
Robert Ferris, MD, PhD

12:00 NOON **LUNCH**

1:00 P.M. **2021 Dickson Prize in Medicine Lecture**
The Plasticity of Aging

Cynthia Kenyon, PhD
Vice President, Aging Research, Calico Life Sciences
American Cancer Society Professor
Emeritus Professor of Biochemistry and Biophysics, UCSF

2:00 P.M. **Session 2: The Biology of Aging**

Moderator: Toren Finkel, MD, PhD

Fertility, Immunity, and the Pursuit of Longevity
Arjumand Ghazi, PhD

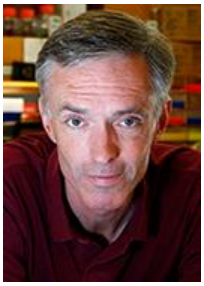
Burning Fat: Good for Aging?
Aditi U. Gurkar, PhD

Dietary Methionine Restriction Started Late in Life Extends Mouse Healthspan
Andrey A. Parkhitko, PhD

3:00 P.M. **Refreshment Break**

3:15 P.M. **2020 Dickson Prize in Medicine Lecture**

Harnessing Synthetic Biology and Deep Learning to Fight Pathogens



James J. Collins, PhD
Termeer Professor of Medical Engineering and Science
Professor of Biological Engineering
Massachusetts Institute of Technology

4:15 P.M. **Session 3: Synthetic Biology in Disease Diagnosis and Treatment**

Moderator: Warren Ruder, PhD

Evolutionary Pathways to Antimicrobial Resistance Diversify on Surfaces
Vaughn Cooper, PhD

Engineering Molecular Switches through Genetic Code Expansion
Alexander Deiters, PhD

The Microbiome and Outcomes of Critical Care
Alison Morris, MD, MS

Synthetic Biology for Next-Generation Medical Robotics
Warren Ruder, *PhD*

5:15 P.M. **Conclusion and Closing Remarks**
Anantha Shekhar, MD, PhD

5:30 P.M. **Reception**
University Club, Gold Room

DICKSON PRIZE IN MEDICINE SPEAKERS

Carolyn Bertozzi, PhD

Carolyn Bertozzi, PhD**,** is the 2022 recipient of the Dickson Prize in Medicine, the University of Pittsburgh School of Medicine's highest honor.

Bertozzi founded the field of "bioorthogonal chemistry," a class of chemical reactions compatible with living systems.

Bertozzi's research interests span the disciplines of chemistry and biology, with an emphasis on studies of how sugar molecules on cell surfaces are important contributors to diseases like cancer, inflammation and bacterial infection. Her lab has identified ways to modify these sugar molecules through bioorthogonal chemistry – a method that employs chemical reactions that do not interfere with normal cellular processes. This approach has allowed her to develop new therapeutic approaches to treat many diseases, including most recently in the field of cancer immunotherapy.

Bertozzi is the Anne T. and Robert M. Bass Professor of Chemistry at Stanford University and a Howard Hughes Medical Institute investigator.

In addition to her research, Bertozzi works actively to translate her science into new therapies. She has cofounded several startups, including Redwood Bioscience, Enable Biosciences, InterVenn Biosciences, OliLux Biosciences and Lycia Therapeutics.

Bertozzi earned her undergraduate degree in chemistry from Harvard University and her PhD in chemistry from the University of California, Berkeley. After completing her postdoctoral research at the University of California, San Francisco, she joined the faculty of the University of California, Berkeley in 1996. A Howard Hughes Medical Institute investigator since 2000, she became a Stanford University faculty member in 2015 and was among the first faculty to join the interdisciplinary institute known as Sarafan ChEM-H (Chemistry, Engineering and Medicine for Human Health). She is now the Baker Family Director of Sarafan ChEM-H.

Bertozzi has received numerous national and international honors and awards for her research, including a MacArthur Fellowship in 1999 and the Wolf Prize in Chemistry in 2022. She is a member of the National Academy of Medicine, the National Academy of Sciences and the American Academy of Arts and Sciences.

James J. Collins, PhD

James J. Collins, PhD, is the 2020 recipient of the Dickson Prize in Medicine, the University of Pittsburgh School of Medicine's highest honor. Collins is a pioneer in synthetic biology whose ideas have contributed to novel diagnostics and treatments targeting infections and complex diseases. Using engineering principles to design and construct synthetic gene networks, he was

one of the first to harness the biochemical and biophysical properties of nucleic acids and proteins to create biological circuits.

A seminal 2000 publication in Nature describing the successful creation of a bistable, synthetic gene switch in *Escherichia coli* has been cited more than 4,000 times and marks the arrival of an important new discipline in biomedicine. Collins later demonstrated that synthetic gene networks can be linked with a cell's genetic circuitry as a regulatory mechanism to create programmable cells for biomedical applications. Along these lines, Collins has created engineered microbes to serve as *in vivo* diagnostics and therapeutics.

More recently, Collins and colleagues developed an innovative platform that embeds freeze-dried, cell-free synthetic gene networks onto paper and other materials, including cloth, with a wide range of potential clinical and research applications. The resulting materials contain properties of a living cell, are stable at room temperature, and can be activated by simply adding water. Of note, Collins' work on freeze-dried, cell-free synthetic biology has established a platform for a new class of rapid, programmable *in vitro* diagnostics for emerging pathogens, including drug-resistant bacteria and viruses.

These paper-based sensors have already been used in clinical trials to diagnose Zika, dengue, chikungunya, and yellow fever, in multiple countries. Additional paper-based diagnostic tests are being created for HIV, malaria, hepatitis C, inflammatory bowel disease (IBD), and Lyme disease. Currently, Collins and his team are using the underlying synthetic biology technology to develop a self-activating COVID-19 face mask as a wearable, rapid diagnostic. Collins is advancing, if not defining, the emerging discipline of synthetic biology with insightful, creative work that is transforming biomedicine.

Collins' patented technologies have been licensed by more than 25 biotech, pharmaceutical, and medical device companies; and he has helped to launch a number of companies, including Synlogic, Sherlock Biosciences, and Senti Biosciences. Synlogic, for example, is using Collins' synthetic gene networks and programmable cells to create a novel class of living medicines to treat rare genetic metabolic disorders, IBD, and cancer. Clinical trials are underway targeting phenylketonuria (PKU) and solid tumors.

Collins is the Termeer Professor of Medical Engineering and Science and professor of biological engineering at the Massachusetts Institute of Technology. He is also affiliated faculty with the Broad Institute of MIT and Harvard and the Wyss Institute at Harvard. He has received numerous awards and honors, including a Rhodes Scholarship, a MacArthur "Genius" Award, an NIH Director's Pioneer Award, the Max Delbruck Prize in Biological Physics, and the Sanofi-Institut Pasteur Award.

Collins is an elected member of the National Academy of Sciences, National Academy of Engineering, National Academy of Medicine, and the American Academy of Arts and Sciences. He is also a charter fellow of the National Academy of Inventors. Collins earned his bachelor's degree in physics at the College of the Holy Cross in Worcester, Massachusetts, before

completing a PhD in medical engineering at the University of Oxford with the distinction of Rhodes Scholar.

Cynthia Kenyon, PhD

Cynthia Kenyon, PhD**,** is the 2021 recipient of the Dickson Prize in Medicine, the University of Pittsburgh School of Medicine's highest honor. Kenyon is a pioneer in the field of aging biology whose research has helped reveal that aging is subject to genetic regulation, overturning the longstanding belief that aging is simply a haphazard decline. She is currently vice president of aging research at the Alphabet subsidiary Calico Life Sciences, a basic research and drug development company seeking to advance our understanding of aging and improve the quality of life as we age.

Kenyon studied chemistry and biochemistry at the University of Georgia, graduating as valedictorian in 1976. She then completed a PhD at MIT with Graham Walker, where she pioneered the identification of genes on the basis of their expression profiles, finding that DNA-damaging agents activate a battery of DNA repair genes in *E. coli*. Kenyon carried out her postdoctoral training with Nobel laureate Sydney Brenner at the Medical Research Council Laboratory of Molecular Biology in Cambridge, UK, studying developmental pattern formation in *C. elegans*, a small roundworm.

Aging had long been considered an inevitable, uncontrollable biological process—but as a faculty member at the University of California, San Francisco, Kenyon challenged this belief. Overturning a longstanding assumption wasn't easy, however. Many of Kenyon's peers were convinced that aging was merely an entropic decline and that looking for genes that actively control the rate of aging was futile. Kenyon initially had trouble recruiting young scientists to her lab who shared her enthusiasm and hopes for aging biology.

Then, in 1993, she and her colleagues made the pioneering discovery that a single mutation in the *daf-2* gene could double the lifespan of healthy, fertile *C. elegans*. Further, the long-lived worms appeared to stay young longer than normal. Her findings showed that aging is indeed subject to genetic regulation, and they sparked an intensive interest in and study of the molecular biology of aging. Her research led to the realization that a universal endocrine network influences the rate of aging of many organisms, possibly including humans.

Kenyon and her lab members have uncovered many genes that regulate aging and revealed that these genes coordinate diverse processes that protect the cells and tissues. She showed that the different tissues of the animal interact with one another to set the overall rate of aging, and that individual neurons, and also germ cells, can control the lifespan of the entire animal.

At UCSF, Kenyon was the Herbert Boyer Distinguished Professor in the Department of Biochemistry and Biophysics and, after joining Calico in 2014, is now an emeritus professor. She has received many honors and awards, including an American Cancer Society Research Professorship, the Dan David Prize, the King Faisal International Prize for Medicine, the

Association of American Medical Colleges Award for Distinguished Research in the Biomedical Sciences, and many others. Kenyon is a past president of the Genetics Society of America and a member of the American Academy of Arts and Sciences, the National Academy of Medicine, and the National Academy of Sciences.

UNIVERSITY OF PITTSBURGH SYMPOSIUM PARTICIPANTS

Kay Brummond, PhD
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Professor of Otolaryngology, of Immunology, and of Radiation Oncology
School of Medicine
Associate Vice Chancellor for Cancer Research
Director, UPMC Hillman Cancer Center

Toren Finkel, MD, PhD
G. Nicholas Beckwith III and Dorothy B. Beckwith Professor of Translational Medicine
Distinguished Professor of Medicine (Division of Cardiology)
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Distinguished Professor of Microbiology and Molecular Genetics, of Medicine (Infectious Diseases), and of Immunology
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Patrick Gallagher, PhD
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