SCIENCE + ENGINEERING = CONQUERING CANCER

TOGETHER

KOCHE INSTITUTE FOR INTEGRATIVE CANCER RESEARCH AT MIT
Cancer research is at an inflection point. In recent decades, researchers at MIT and around the world have developed a vastly more intricate understanding of the biology of cancer, opening new avenues to detect, monitor, treat, and prevent the disease. On a parallel track, a new generation of bioengineers has developed a sophisticated array of tools that has revolutionized our thinking about how we might intervene and to what effect.

The Koch Institute integrates, in very concrete ways, these formerly disparate disciplines, driving enormous benefits for patients and allowing us to translate biological insights into breakthrough advances at breathtaking speed.

Embodying an unprecedented commitment to cross-disciplinary collaboration, the Koch Institute melds the most advanced biological investigation with innovative approaches in engineering and technology. MIT’s 150-year legacy of achievement in science and engineering provides an extraordinary opportunity and, indeed, a responsibility, to actualize this vision.

The Koch Institute comprises more than 50 laboratories and more than 1,000 researchers—including biologists, biological, chemical, mechanical, and materials science engineers, chemists, computer scientists and others—all united in the fight against cancer. We also engage an extensive network of academic medical centers, clinical and industrial partners, physicians, cancer-focused foundations, and individual philanthropists who share our sense of urgency to unravel the complexities of cancer and bring new innovation to the lives of patients today.

We are enormously proud of the work we are doing and the impact it is having on the lives of people affected by cancer. We invite you to learn more and to join us in our mission of conquering cancer together.

Tyler Jacks, PhD
Director, Koch Institute for Integrative Cancer Research
Anh Thai, a member of the Langer Laboratory, tests a novel drug delivery system to determine how quickly it can release therapeutic compounds. One of the key goals of current Koch Institute research is to develop nanotechnology-based therapeutics for more effective targeting of cancer cells.

We are advancing five priority areas of research that address many of the most difficult challenges facing patients and oncologists. In each, cross-disciplinary teams of faculty, students and staff, in collaboration with clinical centers and industry, are working to redefine our response to cancer.
NANO-BASED DRUGS

Most cancer treatments are blunt and toxic instruments, indiscriminately destroying both healthy and cancerous cells. We work at the molecular level to find and destroy cancer cells selectively. Our nanoscale cancer “smart bombs” deploy multiple emerging technologies from the realms of biology and bioengineering.

First, we make highly specific and selective ligands to detect cancer cells through the molecular structures they uniquely express. A conventional drug or toxin, antibody or RNA interference (RNAi) molecule then disables the cancer cells. We package this payload in a nano-sized particle so that it traverses the body efficiently. Our goal is to perfect a new generation of cancer therapies that eliminate cancer cells and leave healthy cells alone.

DETECTION AND MONITORING

Early detection and monitoring is critical to mounting effective cancer treatments. The molecular differences that make cancer cells lethal when left unchecked also provide clues for their detection, identification, and visualization. We are developing highly sensitive technologies, from nanoparticle-derived biomarkers identified by a simple urine test, to deep-tissue imaging systems that reveal tumors smaller than a millimeter, to implantable sensors capable of wireless data transmission. These systems have the potential to reveal cancer at very early stages, and continuously monitor during and after treatment for signals of remission or relapse. These advances will make cancer detection easier, less invasive, less expensive, and more precise. Furthermore, many of these technologies are being adapted to have the capacity for drug delivery. We envision tools that can not only find cancer cells, but also take action to destroy them on the spot, operating at a new interface of detection and treatment.

METASTASIS

Primary tumors are seldom lethal—most cancer deaths are caused by metastasis. Cancer cells mutate and spread to far-flung regions of the body where they are difficult to investigate and eradicate. Too little is known about the molecular and cellular changes that drive metastasis. Under the banner of the Ludwig Center for Molecular Oncology, we are identifying the genes and the cellular interactions that encourage metastatic spread and allow cancer cells to survive and thrive in disparate locations. We are also devising methods to identify and visualize sites of metastasis earlier in the disease. Armed with this knowledge, we aim to combat metastasis before it begins and destroy cancer cells wherever they may hide.

PERSONALIZED MEDICINE

What makes cancer cells different and dangerous? Among the myriad genetic alterations observed in tumors, only some propel cancer cells to proliferate abnormally, survive inappropriately and resist the drugs administered to destroy them. To know which alterations represent important therapeutic targets, we need to understand their place in the vast molecular network that underpins cellular function. We are using multiple genomic, proteomic, computational and in vivo approaches to build a comprehensive “wiring diagram” for cancer cells and their molecular environment. This blueprint will lead us to better, more sophisticated and patient-specific strategies to control cancer and combat drug resistance.

CANCER IMMUNOLOGY

When looking for a strong ally in the fight against cancer, perhaps none is better suited than our own immune system. Every day it is on the hunt for foreign invaders, and is singly effective at eliminating many nascent cancers before they even develop. Yet some cancers escape and turn lethal, for reasons that remain poorly understood. We are helping to illuminate the role of the immune system in fighting cancer using state-of-the-art engineering and analytical methods. Our goal is to create new classes of diagnostics along with novel immunotherapies, which augment and surpass the natural immune response, for the cancers that get away.
The Koch Institute was designed from the ground up to provide a venue for seamless and serendipitous collaboration among more than two dozen extraordinary biology and engineering labs, working together to advance the cause of cancer research. Internationally recognized leaders in their respective fields, our faculty members have earned the most prestigious national and international science honors:

* Five current and former faculty members have been awarded the Nobel Prize
* 17 current faculty members have been elected to the National Academy of Sciences
* Six current faculty members have been elected to the National Academy of Engineering
* Nine current and former faculty members have been awarded the National Medals of Science or Technology and Innovation
* Ten current faculty members are Howard Hughes Medical Investigators.

Our world-renowned faculty unites leadership in multiple fields of science and engineering with a commitment to truly interdisciplinary collaboration. Working with the faculty is a research force of more than 1,000 individuals including postdoctoral fellows, principal research scientists, clinical investigators, students and laboratory staff. As we look beyond our walls, we benefit greatly from the unstinting advice and support of our Director’s Council and Scientific Advisory Board.
INTRAMURAL FACULTY

- MIT SCHOOL OF ENGINEERING
  - ANGELIKA AMON
    - Associate Professor, Chemical Engineering and Institute for Medical Engineering and Science
    - Ph.D. 1997, University of California at Davis

- ANGELA M. BELCHER
  - W.M. Keck Professor of Energy
  - Professor of Materials Science & Engineering and Biological Engineering
  - Ph.D. 1997, University of California, Santa Barbara

- SANGEETA N. BHATI
  - John I. and Dorothy Wilson Professor of Health Sciences and Technology & Electrical Engineering and Computer Science
  - Investigator, Howard Hughes Medical Institute
  - Ph.D. 1997, Stanford University

- PAUL CHANG
  - Assistant Professor of Biology
  - Ph.D. 2002, Stanford University

- JIANZHU CHEN
  - Cottrell Professor of Immunology
  - Professor of Biology
  - Ph.D. 1990, Stanford University

- MICHAEL J. CIMA
  - David H. Koch Professor of Engineering
  - Faculty Director, Lemelson-MIT Program
  - Ph.D. 1986, University of California, Berkeley

- FRANK B. GERTLER
  - Professor of Biology
  - Ph.D. 1992, University of Wisconsin, Madison

- PAULA T. HAMMOND
  - David H. Koch Professor of Engineering
  - Ph.D. 1993, MIT

- MICHAEL HEMANN
  - Associate Professor of Biology
  - Ph.D. 2001, Johns Hopkins University

- SUSAN HOCKFIELD
  - President Emerita and Professor of Neuroscience
  - Ph.D. 1979, Georgetown University School of Medicine

- DAVID E. HOUSMAN
  - Virginia & D.K. Ludwig Professor of Biology
  - Ph.D. 1971, Brandeis University

- RICHARD O. HYNES
  - Daniel K. Ludwig Professor for Cancer Research
  - Investigator, Howard Hughes Medical Institute
  - Ph.D. 1971, MIT

- DARRELL J. IRVINE
  - Director, Koch Institute for Integrative Cancer Research
  - David H. Koch Professor of Biology
  - Daniel K. Ludwig Scholar
  - Investigator, Howard Hughes Medical Institute
  - Ph.D. 1988, University of California, San Francisco

- ANGELA KOEHLER
  - Karl Van Tassel (1925) Career Development Professor
  - Assistant Professor of Biological Engineering
  - Ph.D. 2003, Harvard University

- ROBERT S. LANGER
  - David H. Koch Institute Professor
  - Ph.D. 1974, MIT

- JACQUELINE A. LEES
  - Associate Director, Koch Institute
  - Professor of Biology
  - Ph.D. 1990, University of London

- J. CHRISTOPHER LOVE
  - Associate Professor of Chemical Engineering
  - Ph.D. 2004, Harvard University

- SCOTT R. MANALIS
  - Professor of Biological Engineering and Mechanical Engineering
  - Ph.D. 1998, Stanford University

- RAM SASISEKHARAN
  - Alfred H. Caspary Professor of Biological Engineering & Health Sciences and Technology
  - Ph.D. 1992, Harvard Medical School

- PHILLIP A. SHARP
  - Institute Professor
  - Ph.D. 1969, University of Illinois

- FRANK SOLOMON
  - Professor of Biology
  - Ph.D. 1970, Brandeis University

- MATTHEW G. VANDER HEIDEN
  - Eisen and Chang Career Development Professor
  - Associate Professor of Biology
  - Ph.D. 2000, University of Chicago
  - M.D. 2002, University of Chicago

- FOREST M. WHITE
  - Professor of Biological Engineering
  - Ph.D. 1997, Florida State University

- K. DANE WITTRUP
  - Associate Director, Koch Institute for Integrative Cancer Research
  - Carbon P. Dubbs Professor of Chemical Engineering
  - Professor of Biological Engineering
  - Ph.D. 1988, California Institute of Technology

- MICHAEL B. YAFFE
  - David H. Koch Professor of Science
  - Professor of Biological Engineering
  - Ph.D. 1987, Case Western Reserve University
  - M.D. 1989, Case Western Reserve University

- OMER H. YILMAZ
  - Assistant Professor of Biology
  - Ph.D. 2008, University of Michigan
  - M.D. 2008, University of Michigan Medical School

- PAUL C. CHANG
  - Professor of Materials Science & Engineering
  - W.M. Keck Professor of Energy
  - Daniel K. Ludwig Scholar
  - David H. Koch Professor of Biology
  - Ph.D. 2003, Harvard Medical School

- PH.D. 1999, Harvard University

- PH.D. 1993, MIT

- PH.D. 1987, Case Western Reserve University

- M.D. 1989, Case Western Reserve University

- M.D. 1999, Harvard Medical School

- M.D. 2008, University of Pennsylvania

- M.D. 2002, Yale University

- M.D. 2006, University of Pennsylvania

- M.D. 2008, University of Pennsylvania

- M.D. 1999 Harvard Medical School

- M.D. 1999, Harvard Medical School

- M.D. 2008, University of Michigan

- M.D. 2009, University of Michigan

- M.D. 2002, Yale University

- M.D. 1999, University of Michigan

- M.D. 1999, Harvard Medical School

- FACULTY

- EMERITI FACULTY

- HERMAN N. EISEN
  - M.D. 1943, New York University

- NANCY H. HOPKINS
  - Professor Emerita
  - Ph.D. 1971, Harvard University

- DAVID M. SABATINI
  - Member, Whitehead Institute
  - Professor of Biology
  - Investigator, Howard Hughes Medical Institute

- LEONA D. SAMSON
  - Uncas and Helen Whitaker Professor
  - Professor of Biology and Biological Engineering
  - American Cancer Society Professor

- ALICE TING
  - Ellen Swallow Richards Professor
  - Associate Professor of Chemistry

- GRAHAM C. WALKER
  - Professor of Biology
  - American Cancer Society Professor
  - Howard Hughes Medical Institute Professor

- ROBERT A. WEINBERG
  - Member, Whitehead Institute
  - Director, Ludwig Center for Molecular Oncology
  - David H. Koch Professor of Biology

- RON WEISS
  - Professor of Biological Engineering
  - Director, Synthetic Biology Center

- RICHARD A. YOUNG
  - Member, Whitehead Institute
  - Professor of Biology

- EMERITI FACULTY

- HERMAN N. EISEN
  - Professor Emerita
  - M.D. 1943, New York University

- NANCY H. HOPKINS
  - Professor Emerita
  - Ph.D. 1971, Harvard University

- DAVID M. SABATINI
  - Member, Whitehead Institute
  - Professor of Biology
  - Investigator, Howard Hughes Medical Institute

- LEONA D. SAMSON
  - Uncas and Helen Whitaker Professor
  - Professor of Biology and Biological Engineering
  - American Cancer Society Professor

- ALICE TING
  - Ellen Swallow Richards Professor
  - Associate Professor of Chemistry

- GRAHAM C. WALKER
  - Professor of Biology
  - American Cancer Society Professor
  - Howard Hughes Medical Institute Professor

- ROBERT A. WEINBERG
  - Member, Whitehead Institute
  - Director, Ludwig Center for Molecular Oncology
  - David H. Koch Professor of Biology

- RON WEISS
  - Professor of Biological Engineering
  - Director, Synthetic Biology Center

- RICHARD A. YOUNG
  - Member, Whitehead Institute
  - Professor of Biology

- EMERITI FACULTY

- HERMAN N. EISEN
  - Professor Emerita
  - M.D. 1943, New York University

- NANCY H. HOPKINS
  - Professor Emerita
  - Ph.D. 1971, Harvard University

- DAVID M. SABATINI
  - Member, Whitehead Institute
  - Professor of Biology
  - Investigator, Howard Hughes Medical Institute

- LEONA D. SAMSON
  - Uncas and Helen Whitaker Professor
  - Professor of Biology and Biological Engineering
  - American Cancer Society Professor

- ALICE TING
  - Ellen Swallow Richards Professor
  - Associate Professor of Chemistry

- GRAHAM C. WALKER
  - Professor of Biology
  - American Cancer Society Professor
  - Howard Hughes Medical Institute Professor

- ROBERT A. WEINBERG
  - Member, Whitehead Institute
  - Director, Ludwig Center for Molecular Oncology
  - David H. Koch Professor of Biology

- RON WEISS
  - Professor of Biological Engineering
  - Director, Synthetic Biology Center

- RICHARD A. YOUNG
  - Member, Whitehead Institute
  - Professor of Biology

- EMERITI FACULTY

- HERMAN N. EISEN
  - Professor Emerita
  - M.D. 1943, New York University

- NANCY H. HOPKINS
  - Professor Emerita
  - Ph.D. 1971, Harvard University

- DAVID M. SABATINI
  - Member, Whitehead Institute
  - Professor of Biology
  - Investigator, Howard Hughes Medical Institute

- LEONA D. SAMSON
  - Uncas and Helen Whitaker Professor
  - Professor of Biology and Biological Engineering
  - American Cancer Society Professor

- ALICE TING
  - Ellen Swallow Richards Professor
  - Associate Professor of Chemistry

- GRAHAM C. WALKER
  - Professor of Biology
  - American Cancer Society Professor
  - Howard Hughes Medical Institute Professor

- ROBERT A. WEINBERG
  - Member, Whitehead Institute
  - Director, Ludwig Center for Molecular Oncology
  - David H. Koch Professor of Biology

- RON WEISS
  - Professor of Biological Engineering
  - Director, Synthetic Biology Center

- RICHARD A. YOUNG
  - Member, Whitehead Institute
  - Professor of Biology

- EMERITI FACULTY

- HERMAN N. EISEN
  - Professor Emerita
  - M.D. 1943, New York University

- NANCY H. HOPKINS
  - Professor Emerita
  - Ph.D. 1971, Harvard University
Creative exploration at the leading edge of cancer research has often led to important, transformative new discoveries, bringing major improvements in patient care. All too often, however, early-stage ideas do not qualify for funding from traditional government sources. The Koch Institute is deeply committed to supporting boldly conceived, highly innovative and collaborative research proposals from our faculty, students, fellows and clinical investigators. The initial projects supported by the Koch Institute represent an investment in the future and highlight the far-reaching vision of our community.

Pushing New Boundaries

The Koch Institute Frontier Research Program is already supporting exciting, interdisciplinary investigations, including:

- A genetic marker for metastatic breast cancers that has been licensed for the development of clinical diagnostic tests
- New devices and treatments to more safely and effectively deliver chemotherapy to ovarian cancer patients
- Injectable nanoparticles that create urinary biomarkers to reveal the presence and type of cancer
- A simple, staggered drug delivery regimen to increase the effectiveness of current therapies for aggressive triple-negative breast cancer
- An imaging system for early detection and surgical resection, that is capable of revealing tiny, deep-seated tumors smaller than a millimeter

Nate Cermak, a researcher in the Manalis Laboratory, is developing a microcantilever device for high-throughput analysis of single cell growth. High precision measurements of individual cells help reveal growth changes that accompany the onset, progression, and treatment response in cancer.

A Future Without Cancer

The Koch Institute hopes to transform cancer from a deadly disease to one that is well understood, manageable and even, one day, preventable. Our paradigm-changing integrative approach to cancer research, and our commitment to supporting highly creative people and ideas, is changing the course of cancer for patients and their families. Fueled by Frontier Research Program funding, MIT teams embody a wellspring of innovation.
The Koch Institute depends on gifts from generous donors to support our unique community and outstanding research. Working with philanthropic individuals, foundations and corporate partners, we leverage current use and endowed funds to advance and expand the impact of the work we are doing today and to build the future of cancer research at MIT.

Gifts are welcome in any amount and in many forms for the following high impact priorities:

- **The Koch Institute Director’s Fund:** Providing unrestricted support for the Koch Institute, applied to areas of greatest need.

- **The Koch Institute Frontier Research Fund:** Advancing early-stage, highly innovative cancer research projects that have the potential for groundbreaking translational discoveries yet fall outside the parameters of traditional sources of research funding.

- **The Swanson Biotechnology Center (SBC):** A suite of sophisticated core technology facilities that supports and enables MIT cancer research teams, and expands our capacity to conduct leading-edge cancer research.

### Naming Opportunities

The Koch Institute offers a range of naming opportunities: research funds propelling bold new ideas toward clinical applications; cancer-focused fellowships for MIT graduate students and postdoctoral researchers; faculty chairs advancing the integration of science and engineering; and designated laboratory and public spaces within the Institute’s state-of-the-art cancer research center.

For more information on making a gift to the Koch Institute, please contact:

**Lisa Marks Schwarz**
Managing Director of Development
Koch Institute for Integrative Cancer Research at MIT
77 Massachusetts Avenue, 76-158
Cambridge, MA 02139
617.324.2169
lms1@mit.edu

For media inquiries:

**Kevin Leonardi**
Communications Coordinator
Koch Institute for Integrative Cancer Research at MIT
77 Massachusetts Avenue, 76-158
Cambridge, MA 02139
617.324.7795
kevinleo@mit.edu

The Koch Institute thanks Jeffrey L. (1968) and Mary Kay Silverman for providing catalytic support for the Koch Institute’s Communications Initiative.