SCIENCE AND ENGINEERING... CONQUERING CANCER TOGETHER

THE DAVID H. KOCH INSTITUTE FOR INTEGRATIVE CANCER RESEARCH AT MIT
This is an incredible moment in cancer research. In the past two decades, we have developed a vastly more intricate understanding of the molecular basis 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 new tools that have revolutionized our thinking about how we might intervene and to what effect.

This is the moment when bringing these formerly disparate research disciplines together will drive enormous benefits for patients and allow us to translate biological insights into breakthrough advances at breathtaking speed.

The Koch Institute represents an unprecedented commitment to cross-disciplinary collaboration, melding the most advanced biological investigation with the most innovative approaches in engineering and technology. MIT’s 150-year legacy of achievement in science and engineering provides an extraordinary opportunity to achieve this vision – and a deep sense of responsibility to do so.

The Koch Institute brings together more than 50 laboratories and more than 1,000 researchers—including cancer biologists, genome scientists, chemists, physicians, engineers and computer scientists—all united in the fight against cancer. Beyond our walls we engage a broad community of clinicians, academic medical centers, industrial partners, cancer-focused foundations and individual philanthropists working together with a sense of urgency to help us 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
Director, The David H. Koch Institute for Integrative Cancer Research
TACKLING CANCER’S MOST INTRACTABLE CHALLENGES

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.

Sangwon Byun, a post-doctoral researcher in the Manalis Laboratory, works on a tiny device called a suspended microchannel resonator. The device weighs single cells with incredible precision, providing new insights into cancer cell growth.
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
To arrest cancer before it kills, we need to find it early and track its progress. The molecular differences that make cancerous cells lethal when left unchecked also provide the necessary clues to detect and identify them. We are developing highly sensitive cancer detectors through advances in molecular imaging and micro-electromechanical systems (MEMS) technologies. Implantable detectors, combined with wireless data transmission technologies (telemetry), will enable continuous monitoring of cancer patients to immediately signal remission or relapse. At the interface of detection and treatment, these implantable detectors will one day trigger micro-scale drug delivery systems for automatic therapeutic interventions, and may also ensure that the drugs being used are in fact reaching and killing the tumor.

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 that encourage metastatic spread and allow cancer cells to survive and thrive in disparate locations. We are also developing 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 has earned the most prestigious national and international science honors:

- Five current and former faculty have been awarded the Nobel Prize
- 15 current faculty are members of the National Academy of Sciences
- Five current faculty are members of the National Academy of Engineering
- Seven current and former faculty have been awarded the National Medal of Science
- Nine current faculty 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 of our Leadership Council and Scientific Advisory Board.
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.

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**Pushing New Boundaries**

**The Frontier Research Program**

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**At the Frontline**

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

- New ways to detect, capture and characterize circulating tumor cells (CTCs);
- Methods to reactivate the tumor-specific immune cells in melanoma patients;
- New devices to more safely and effectively deliver chemotherapy to ovarian cancer patients;
- New methods to use light activated gold nano-rods in reducing tumor burden in sarcomas;
- New inhaled nano-particle formulations to deliver small interfering RNA (siRNA) molecules into the lungs of cancer patients;
- Advanced genetic and proteomic tools to understand the specific characteristics of metastatic colorectal cancer lesions, with the goal of developing more effective personalized cancer treatments;
- New surgical tools that facilitate the real-time detection of residual cancer cells during surgery;
- And many more.

**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 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 well-spring of innovation.
The Koch Institute depends on gifts from generous donors to support our unique facilities and outstanding research. Gifts are welcome in any amount and in many forms including cash, stock, or other assets, for the following high impact priorities:

- **The Swanson Biotechnology Center (SBC):** Highly sophisticated core technology facilities that support and enable MIT cancer research teams, and expand our capacity to conduct leading-edge cancer research.

- **The Center for Nanotechnology Science (cNs):** Nanotechnology-focused research labs, including a state-of-the-art Nanomaterials Characterization Facility and a dynamic set of nanotechnology-based cancer research initiatives, hosting training opportunities for MIT graduate and undergraduate students.

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

- **Honoring the Legacy of Salvador E. Luria:** A project to commemorate the achievements of the faculty of MIT’s Center for Cancer Research (CCR) and its founding Director, Nobel Laureate Professor Salvador E. Luria. The CCR was the predecessor to the Koch Institute.

- **The Koch Institute Gift Fund:** Providing unrestricted support for the Koch Institute by directing gifts to where they are most needed.

**Naming Opportunities**

Your name or that of a beloved one can be associated with a range of naming opportunities at the Koch Institute: laboratory and public spaces within the Institute’s new state-of-the-art cancer research center; cancer-focused fellowships for MIT graduate students and postdoctoral researchers; faculty chairs advancing the integration of science and engineering; and research funds propelling bold new ideas toward clinical applications.

The first floor of the Koch Institute is meant to engage the public; attractions include the Koch Institute Public Galleries, the Koch Cafe, and this new work by sculptor Martin Boyce.

*Architect: Ellenzweig
Construction: Berry, a Division of Suffolk*