WHY HERE?

Researchers at the Koch Institute develop innovative drug delivery systems for effective cancer treatment. This hydrogel, created by engineers in the Langer and Anderson Laboratories, protects biological or chemical agents as they make their way through the body to fight disease.
WHY NOW?

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
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.

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.
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. Collaborating within the nexus of the Marble Center for Cancer Nanomedicine, we devise 'smart' nanoscale cancer medicines that leverage multiple emerging technologies from the fields of biology and bioengineering.

**NANO-BASED DRUGS**

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
• Seven current faculty members have been elected to the National Academy of Engineering
• Nine National Medals of Science or Technology and Innovation have been awarded to current and former faculty members
• Eleven 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.
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.

**THE FRONTIER RESEARCH PROGRAM**

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

**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.

**PUSHING NEW BOUNDARIES**

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.
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:

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This image, captured by Brett Zani of the Edelman Laboratory, shows a breast cancer cell extending its cytoskeleton over the tops of endothelial cells. Researchers are studying how such protrusions affect communication and migration among both healthy and cancerous cells.
The Koch Institute Public Galleries, located on the ground floor, host multimedia exhibits and public programs to engage visitors in the images and stories of integrative cancer research.

*Architect* Ellenzweig  
*Design* Biber Architects and Pentagram