The Koch Institute for Integrative Cancer Research at MIT was founded in 2007 and opened at its current facility on March 4, 2011. By combining the biology faculty of the former MIT Center for Cancer Research with cancer-oriented engineers drawn from across the MIT School of Engineering, the Koch Institute continues a tradition of scientific excellence while directly promoting innovative solutions for the improved detection, monitoring, treatment, and prevention of cancer.

The Koch Institute Public Galleries were established to connect the community in Kendall Square and beyond with the work of the Koch Institute. Within the Galleries, visitors can explore current research projects, examine striking biomedical images, hear personal reflections on cancer and cancer research, and investigate the historical, geographical, and scientific contexts out of which the Koch Institute emerged. Further information about the work of the Koch Institute is available online at ki.mit.edu.

The Koch Institute is deeply grateful to Charles B. and Ann Johnson for their generous gifts establishing the Philip Alden Russell (1914) Gallery at the Koch Institute and providing ongoing support for exhibit revitalization.
A Human Endeavor

Cancer is personal. No statistic can convey the hardships that cancer patients and their families endure; no publication can summarize the lifelong efforts of cancer researchers. This video installation explores diverse personal perspectives on cancer and cancer research through an ongoing interview series.

“We will make important discoveries. We will develop new technologies. But at the end of the day we will impact patients’ lives. And for me, it will be especially satisfying when we’re able to connect very directly from discoveries in our laboratories to better outcomes for patients.”

“In the midst of my Ph.D. studies, my father was actually diagnosed with prostate cancer. You just think about cancer in the abstract as this beast that you’re clawing against and trying to slay. But when it becomes kind of a more personal thing and a more personal concern, I think you realize the impact that it has.”

“Five and a half years in, my husband still can’t say the word cancer. I own it. Yes, I have cancer. And that’s okay. It’s not great. I’d prefer not to. But at the same time, life goes on.”

“I’ve had several phone calls from people that I don’t even know that have been staring at this cancer thing either like a four year old child or a 25 year old child, and they’ve had no good news at all. They hear a little bit about what’s going on at MIT, and they’ve called me and want to hear some of the story because this is some good news. We’re not going to solve it this afternoon, but MIT’s resources with science and engineering are really honing in on this thing, and its seems to mean quite a bit to a lot of people.”

“If there’s any message I try to get across to people when I meet them, it’s that things might not be as bad as you might expect. We’re doing better. We’re making progress. We have a much better understanding of what causes cancer, and not only general cancers but individual patients’ tumors. And now we have drugs that can target some of those weak areas.”

“It was when I was in fifth grade that my teacher walked into the room and said, “Okay boys and girls, close your books. We’re going to talk about, ‘What is life?’” I remember after an hour of that discussion, of trying to figure out what the heck life was, I was just so astonished. I thought, ‘Gee, this is really cool.’ And I don’t think I ever stopped wondering about it from that moment on.”
A Convergent Moment

It is no coincidence that the Koch Institute’s cross-disciplinary approach to cancer has emerged first at MIT, where both engineering and science have thrived since 1861. This exhibit reflects on the rich parallel histories of these disciplines during MIT’s first 150 years. The timeline is unfinished; it closes with an opening, anticipating many more milestones to follow.
The Koch Institute is in the heart of Kendall Square, a center of innovation and commerce since the nineteenth century. Formerly a thriving home for the manufacture of everything from rubber to chocolate and soap, Kendall Square today hosts more than 150 high-tech companies, including some of the most esteemed technology, biotech, and pharmaceutical companies in the world. The Koch Institute itself is sited in the former location of the United-Carr Fastener Corporation, a manufacturer of metal parts for clothing and automobiles.

Cancer Research Stories

What do cancer researchers do? What tools do they use? What questions do they try to answer? This exhibition samples five current stories of cancer research at the Koch Institute through a series of interactive animations. Each story aligns with one of the Koch Institute’s research focus areas. Alongside the animations, the material culture of 21st century cancer research is displayed through a selection of objects from Koch Institute laboratories. These include specimens, devices, models, and other samples of the work of a cancer researcher.

CANCER NANOMEDICINE
DETECTION AND MONITORING
METASTASIS
PRECISION CANCER MEDICINE
CANCER IMMUNOLOGY
The Art of Convergence

Scientific data come in many flavors and types, but a special place is reserved for images. Micrographs, MRI scans, and other biomedical images serve as windows through which experts and non-scientists alike can glimpse otherwise invisible biological worlds. The advancement of imaging technologies through science—and of science through imaging—exemplifies the progress that can be made at the interface of biology and engineering.

The annual Koch Institute Image Awards were established to recognize and publicly display these extraordinary visuals. From more than 160 submissions to the 2019 contest, ten winning images were selected by a panel of expert judges to appear in the Galleries.

2019 SELECTION PANEL

Alissa Ambrose  
Deputy Director, Multimedia & Creative, STAT

Janis Fraser, PhD ’76 (VII)  
Principal, Fish & Richardson P.C.

Salil Garg, MD, PhD  
Charles W. and Jennifer C. Johnson Clinical Investigator, Koch Institute at MIT

James Goodwin  
Principal, Half Moon, LLC

Dan Hart  
Senior Developer, WGBH

Anne E. Havings  
Estrella and Yousaf Karash Chair of Photography  
Museum of Fine Arts, Boston

Allison Johnson  
Interior Designer and Art Consultant,  
Allison Johnson Design

Anh Nguyen, PhD  
Reviews Editor, Cell Stem Cell, Cell Press

Fredericka Stevenson  
Chair, Smithsonian Science Education Center  
Member, Smithsonian National Board  
Founding Board Chair, Summer Search Boston

WINNERS OF THE 2019 KOCH INSTITUTE IMAGE AWARDS

CIRCUIT TRAINING: SHINING A LIGHT ON NEURAL DEVELOPMENT

Matheus Victor, Li-Huei Tsai  
Picower Institute for Learning and Memory

IN GOOD SHAPE: USING MACHINE LEARNING TO IMPROVE CANCER THERAPY

Daniel Reker, Jee Won Yang, Natsuda Navamajiti, Ruoman Cao, Dong Soo Yun, Giovanni Traverso, Robert Langer  
Koch Institute at MIT

Proper brain function depends on the balance between the activity of excitatory and inhibitory neurons. In the synthetic brain circuit seen here, engineered light-activated neurons (blue and white) respond to stimulation patterns that mimic excitatory signals from the developing brain. The electrodes in the foreground record the transmission of signals between cells, revealing important information about the development of neural networks. The Tsai Lab studies how rhythms generated by synchronicity between excitation and inhibition are impaired in Alzheimer’s disease.

This image juxtaposes a molecular dynamics simulation (left) and an electron microscopy image (right) of sorafenib. Sorafenib, like many other cancer drugs, can spontaneously form intricate nano-scale structures that change how the drug behaves.

The Langer Lab uses smart algorithms to compare simulations to reality and analyze or predict the assembly of these nanostructures under various conditions. Their findings allow them to design better versions of the drugs to improve patient outcomes.
Cell therapy comes from within. Researchers in the Langer and Anderson laboratories are engineering “smart” cells (blue) and seeding them on an implantable chip (black). As the cells mature (green), they secrete proteins (red) that can fight disease in the surrounding tissue by responding to the conditions therein.

The biocompatible device not only allows the cells to grow in their natural environment and deliver exactly the right amount of drug when needed, it also protects the system from destruction by immune cells.

As the key player translating DNA code into cellular action, RNA provides important insight into cells’ past, present, and future. Shalek Lab researchers have sequenced the RNA expression of 45,782 single cells from 14 different organs to create an atlas of healthy cell physiology for reference in studies of various disease states including HIV and cancer. The team uses machine learning to map the relationships (lines) between the various subpopulations of cells (dots). Each color signifies a different tissue of origin; together, they present a broad spectrum of cell behavior.

Biology is combinatorial by nature. Complex biological challenges, such as those in agricultural ecology or cancer therapy, may require solutions with multiple components. The Blainey Lab builds soft plastic chips, each the size of a credit card, to rapidly screen thousands of microbes or compounds for “hit” combinations that promote health or defeat disease. Seven droplets, each containing one component, are merged within a single hexagonal well. Researchers examine images of the resulting pool to identify desirable interactions. In this particular experiment, green means go—a promising hit ready for further testing.

Special operatives and frontline defenders against infection and disease, natural killer (NK) cells are the ninjas of the immune system. The Bhatia and Alter Labs seek to visualize the process of activation and attack. The NK cell seen here has been deposited on a glass slide alongside parasites and therapeutic antibodies. Preparing for battle, its surface transforms from smooth to bumpy and protrusions start to emerge. Malaria is the enemy this time, but similar approaches are also being tested against cancer.
EPIGENETICS EXPRESS: TRACKING DNA METHYLATION IN REAL TIME
Yuelin Song, Rudolf Jaenisch
Whitehead Institute and Koch Institute at MIT

NOTHING TO SNEEZE AT: INSPIRATION AND RESPIRATION IN A DISH
Raghu Chivukula, David Mankus, Margaret Bisher, Abigail Lytton-Jean, David Sabatini
Massachusetts General Hospital, Koch Institute at MIT, and Whitehead Institute

WHERE THE WILD TYPES ARE: EXPLORING THE ROOTS OF DEVELOPMENTAL BIOLOGY
Nicki Watson, Mary Gehring
Whitehead Institute

MOTION IN THE OCEAN: USING SEA URCHINS TO UNDERSTAND CELL MIGRATION
Genevieve Abbruzzese, Richard Hynes
Koch Institute at MIT

How do genetically identical cells give rise to diverse tissue types? The Jaenisch Lab studies the epigenetic mechanisms that determine if and when genes are expressed in a cell, leading to variations in gene activity.

In this 3D image of developing cells, different colors represent different activation states of an epigenetic process—DNA methylation—that suppresses gene activity. Analyzing epigenetic changes in real time across complex tissues and cell types at high resolution helps researchers understand how cells develop, and what goes wrong in cancer and other diseases.

Inspired by a patient’s mysterious breathing disorder, MGH and MIT researchers set out to understand it by growing human airway cells in a dish. Derived from adult stem cells, the resulting tissue (seen here) allows a detailed view of cilia (hair-like filaments) in a fully differentiated airway epithelium—the respiratory tract’s frontline defense system. By manipulating genes in the model, the clinician-scientists were able to discover and characterize a rare genetic condition in the patient responsible for impaired ciliary function.

Cancer cells exhibit many similarities to embryonic cells, including the ability to travel to distant and precise locations. As cells move, tracks of fibrous proteins facilitate their migration.

The Hynes Lab uses sea urchins to study these processes—and proteins—in three dimensions. Peering inside transparent embryos, researchers observe glassy, newly formed matrices of fibers around dark skeletons. Determining how cells use this matrix to guide their path through the embryo may provide valuable clues for understanding the mechanisms that promote cell migration during both development and cancer metastasis.

At the heart of modern biology lies the model organism—a living system that can be easily maintained and manipulated in the laboratory to shed light on biological processes. The Gehring Lab uses the model organism Arabidopsis lyrata to interrogate how different genes are expressed as they pass from parent to offspring. This electron micrograph shows the plant’s flower, highlighting the male (yellow) and female (green) reproductive organs in their unmodified, or wild type, state. Through images like these, the W.M. Keck Microscopy Facility helps researchers step out of the weeds of their investigations and bring the beauty of biology into bloom.
Koch Institute Public Galleries
500 Main Street, Cambridge, MA

[INFO]
web ki-galleries.mit.edu
email kigalleries@mit.edu

[HOURS]
8am–6pm, Mon–Thu
8am–4pm, Fri
Admission is free

[OTHER VISITOR ATTRACTIONS AT MIT]
MIT Museum
MIT List Visual Arts Center and public art tour
Maihaugen Gallery, MIT Libraries
MIT Media Lab
Ray and Maria Stata Center
Corridor Lab in Strobe Alley, MIT Edgerton Center

cover art
In Good Shape
Daniel Reker, Jee Won Yang, Natsuda Navamajiti, Ruonan Cao, Dong Soo Yun,
Giovanni Traverso, Robert Langer (Langer Lab, Koch Institute at MIT)