Convergence, Cancer Research and the Koch Institute Experience at MIT

Tyler Jacks
Director

NAS Workshop on Team Dynamics and Effectiveness
July 1, 2013

KOCH INSTITUTE
for Integrative Cancer Research at MIT

KOCH INSTITUTE
for Integrative Cancer Research at MIT

science + engineering...conquering cancer together

PEOPLE RESEARCH APPROACH NEWS + EVENTS SWANSON BIOTECHNOLOGY CENTER SUPPORT

MIT
CENTER FOR
CANCER RESEARCH

President Richard Nixon signing the National Cancer Act on December 23, 1971.

"I will ask for an appropriation of an $100 million to launch an intensive campaign to find a cure for cancer ... the time has come in America when the same kind of concentrated effort that split the atom and took man to the moon should be turned toward conquering this dread disease."

MIT Center for Cancer Research

NCI Cancer Centers

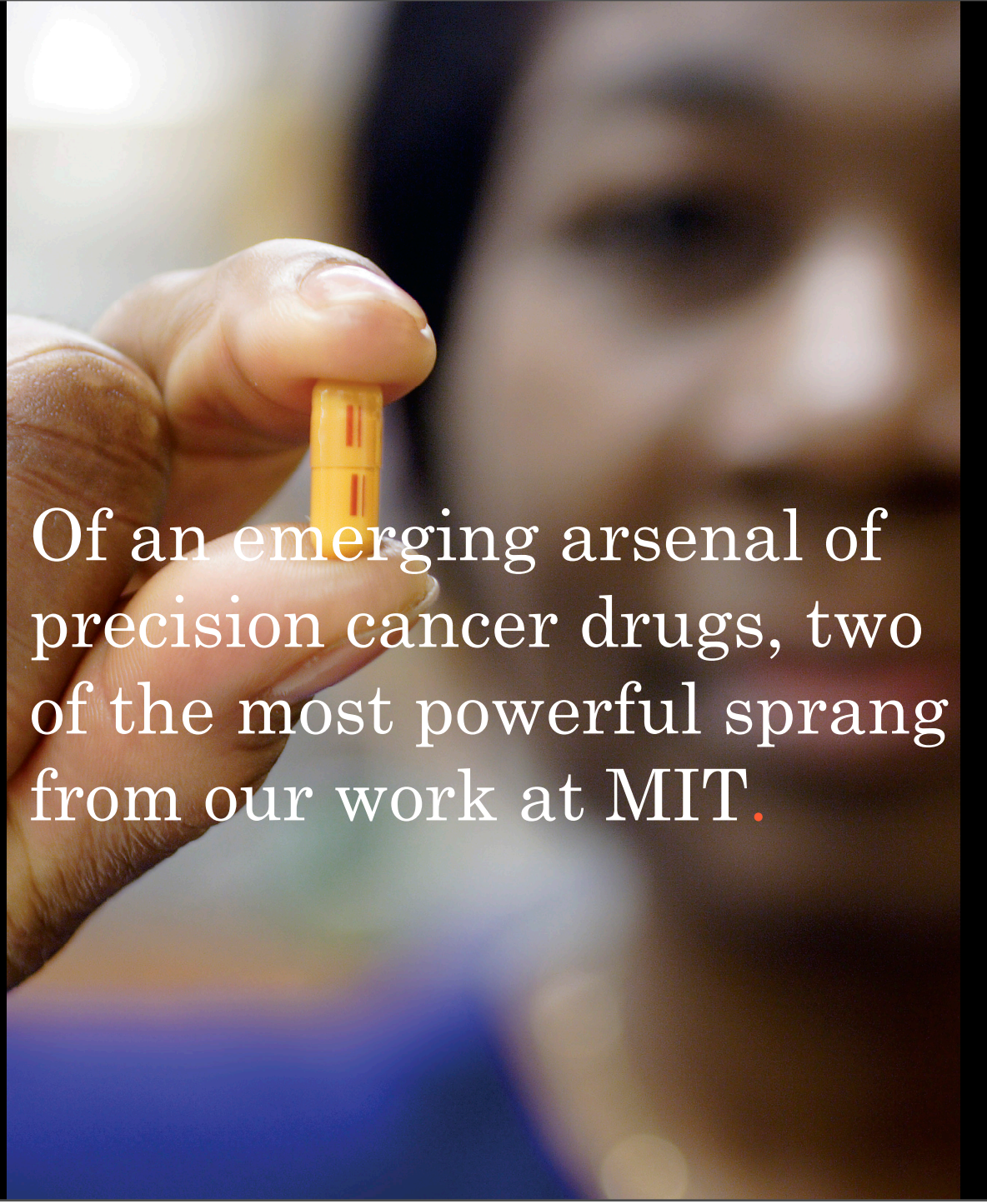
Salvador E. Luria, 1969

H. Robert Horvitz, 2002

David Baltimore, 1975

Susumu Tonegawa, 1987

Phillip A. Sharp, 1993

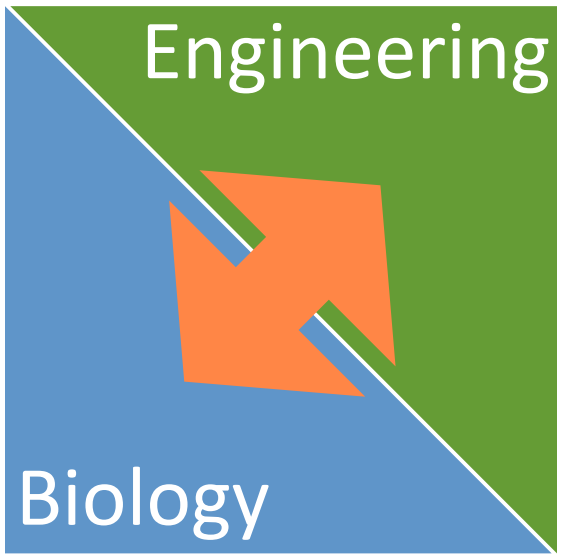

Of an emerging arsenal of precision cancer drugs, two of the most powerful sprang from our work at MIT.

October, 2005: MIT CCR awarded one of seven inter-disciplinary NCI grants to form a Center for Excellence in Cancer and Nanotechnology

October, 2004: MIT CCR awarded one of nine inter-disciplinary NCI grants to use computational and mathematical ("systems") approaches to understand complex problems in cancer biology

National Cancer Institute
PHYSICAL SCIENCES in ONCOLOGY

The Koch Institute: A New Model for Cancer Research



Integration and Collaboration

Discoveries and Solutions

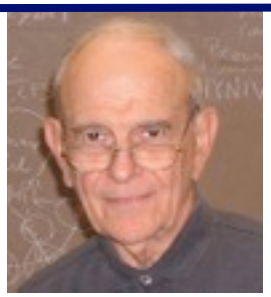
KOCH INSTITUTE for Integrative Cancer Research at MIT

Intramural Koch Institute Biology Faculty

Angelika Amon

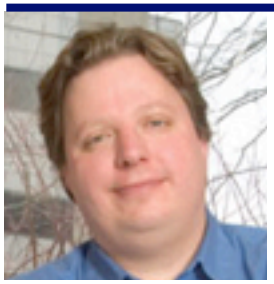
Paul Chang

Jianzhu Chen



Herman Eisen

Frank Gertler



Michael Hemann

Nancy Hopkins

David Housman

Richard Hynes

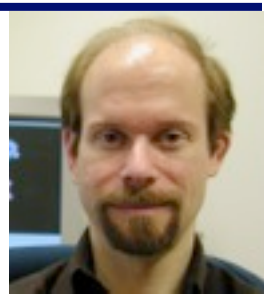
Tyler Jacks

Jacqueline Lees
Assoc. Director

Phil Sharp

Frank Solomon

Matthew
Vander Heiden



Michael Yaffe

Intramural Koch Institute Engineering Faculty

Daniel Anderson
Asst. Professor
Chemical Engineering,
Health Sci. Tech.

Sangeeta Bhatia
Professor
Health Sci. Tech,
Elec. Engineering
& Comp. Science

Angie Belcher
Professor
Material Science
& Engineering,
Biological Engineering

Michael Cima
Professor
Material Science
& Engineering

Paula Hammond
Professor
Chemical
Engineering

Darrell Irvine
Assoc. Professor
Material Science
& Engineering,
Bio. Engineering

Robert Langer
Professor
Chemical Engineering,
Biological
Engineering

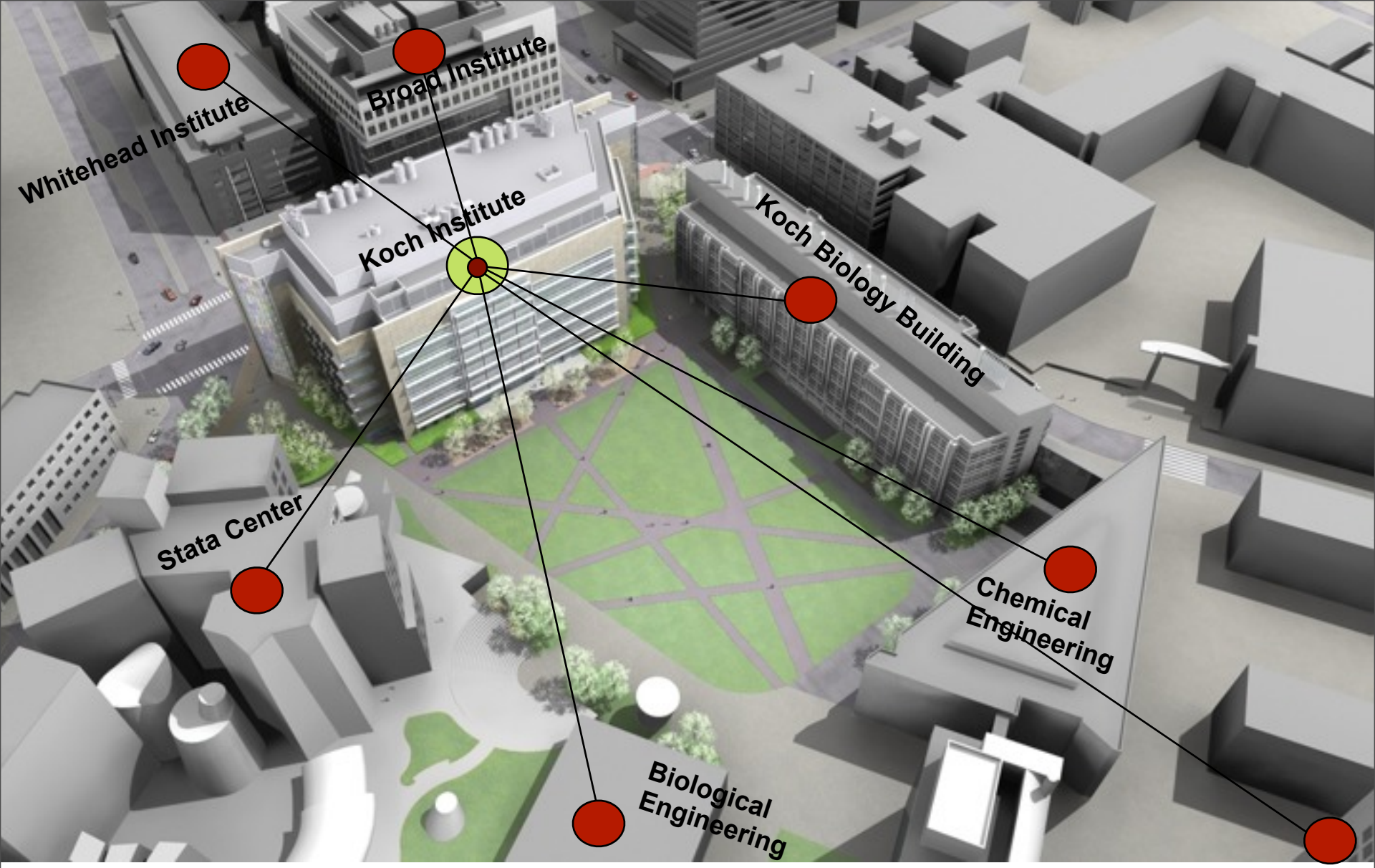
Christopher Love
Asst. Professor
Chemical
Engineering

Scott Manalis
Assoc. Professor
Biological
Engineering,
Mechanical
Engineering

Ram Sasisekharan
Professor
Biological Engineering,
Heath. Sci. Tech.

Forest White
Assoc. Professor
Biological
Engineering

K. Dane Wittrup
Professor
Chemical
Engineering,
Biological
Engineering
Assoc. Director



The Hub of Cancer Research at MIT

KOCH INSTITUTE
for Integrative Cancer Research at MIT

From Renderings to Reality

The Boston Globe

Friday, March 4, 2011

In the news

Local consultants aided Khadafy

Cambridge firm tried to polish his image

By Farah Stockman

Iron hand in Tripoli

Doctor indicted in 6 drug fatalities

Prescriptions said to lead to overdoses

Nurse practitioner also faces charges

By Milton J. Valencia

Joseph Zolot practiced in Needham.

PULLING TOGETHER IN CANCER FIGHT

Doris Gabriel worked on her postdoctoral research at the David H. Koch Institute for Integrative Cancer Research.

In new facility, MIT and philanthropist unite diverse specialists in common quest

By Stephen Smith

David H. Koch Institute for Integrative Cancer Research

Mayor plans partnership to revive Dudley Sq.

School Dept. would go to landmark building

By Michael Levenson

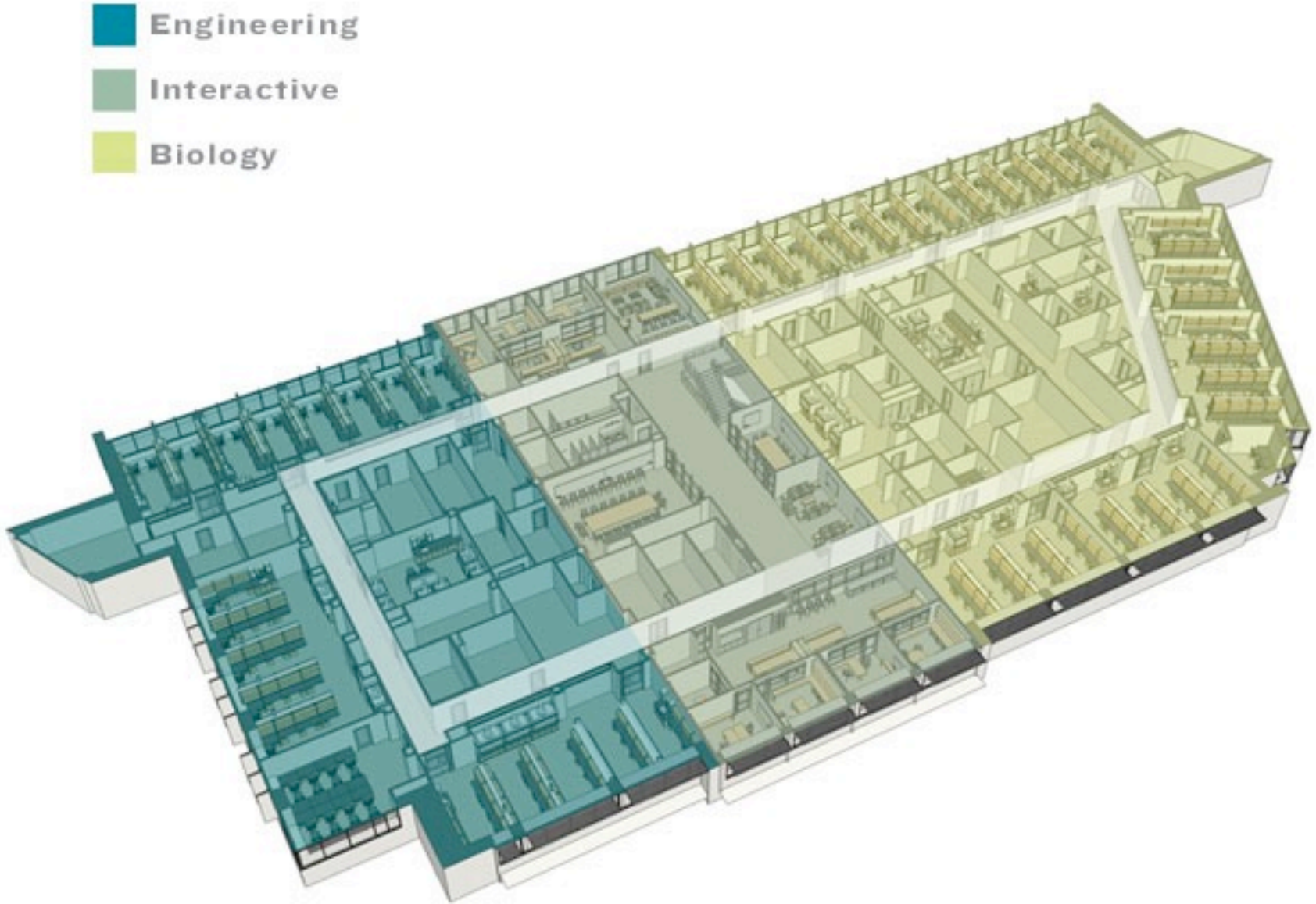
Vivid art offers a window into intricate science

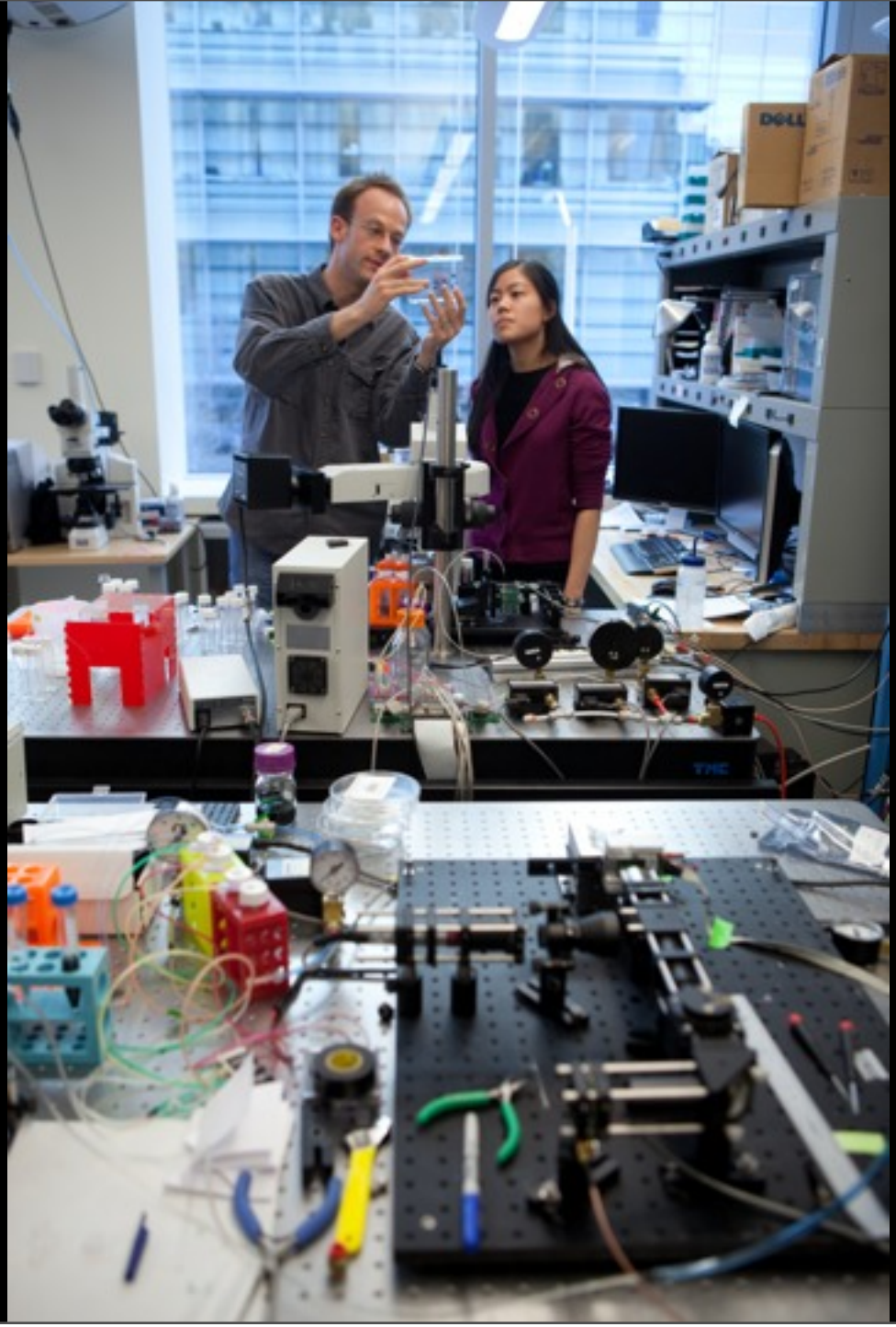
By Mark Feeney

CRITIC'S NOTEBOOK

boston.com


>192,000 NASF
~27 Faculty Laboratories
>22,000 NASF of core facilities
KOCH INSTITUTE
for Integrative Cancer Research at MIT


Engineering
Interactive
Biology


DELL


Koch Institute Public Galleries
Localization of PARP-16 Protein in HeLa Cells, Version #2
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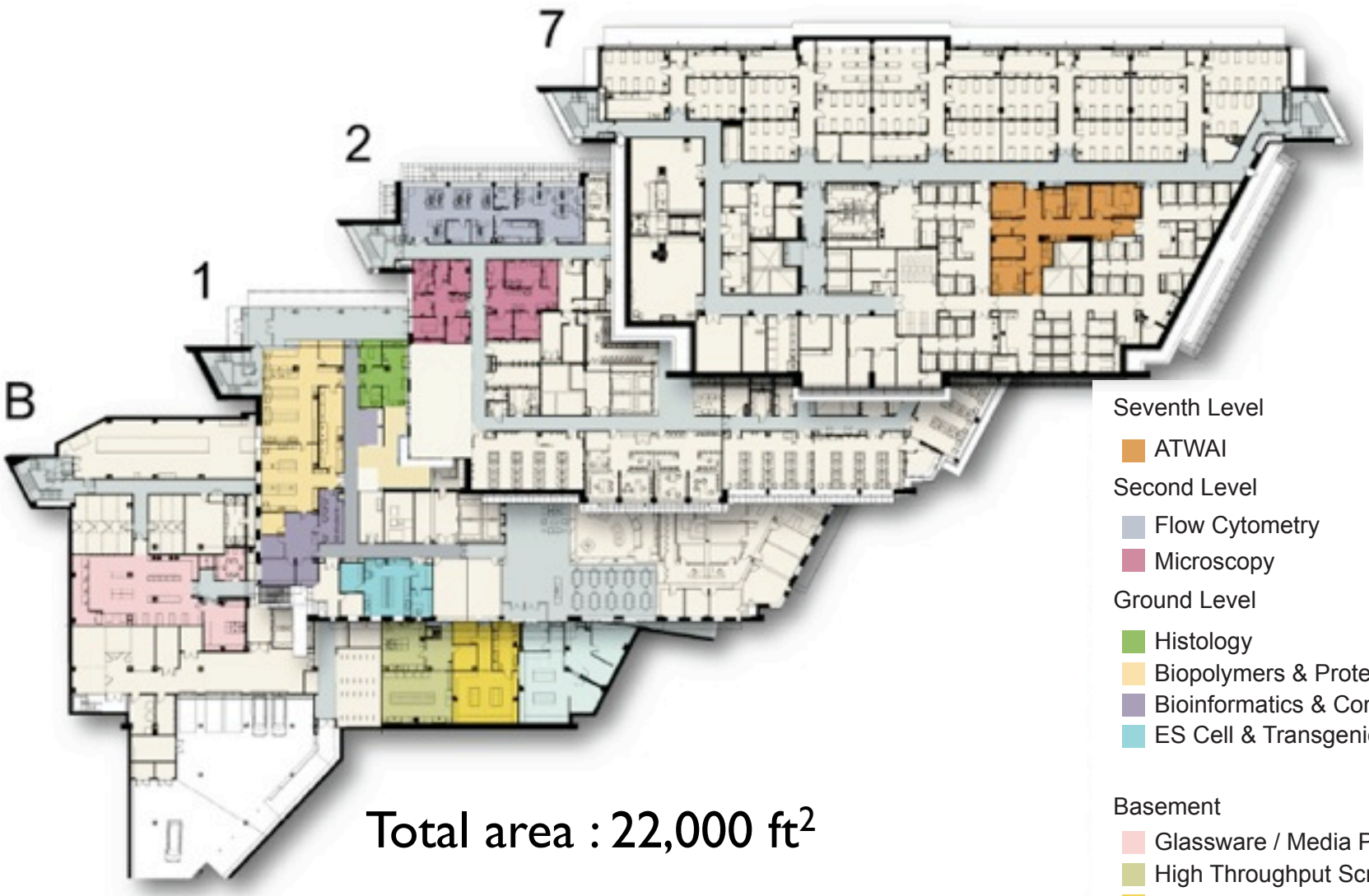
READ


MAIN STREET
GALLERY
HEAD-
QUARTERS
SWANSON
BIOTECHNOLOGY
CENTER
KOCH CAFE


STONY BRO
PUMA

The KI Core Facilities have been organized into the Swanson Biotechnology Center



Total area : 22,000 ft^2

From Convergence to Confluence

KOCH INSTITUTE
FRIDAY FOCUS SEMINAR SERIES

PROF HAMMOND & JASON DENG:
HAMMOND LAB

ATTACK OF THE LAYER-BY-LAYER NANOPARTICLES:
CO-DELIVERY OF CHEMODRUG AND RNAI FOR CANCER TREATMENT

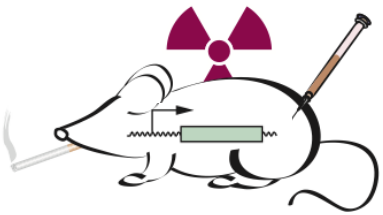
FRIDAY, APRIL 12TH, 4:30 PM
KOCH INSTITUTE AUDITORIUM
Social Hour hosted by the Hammond Lab (5th floor)

KOCH INSTITUTE
for Integrative Cancer Research at MIT

CROSSFIRE

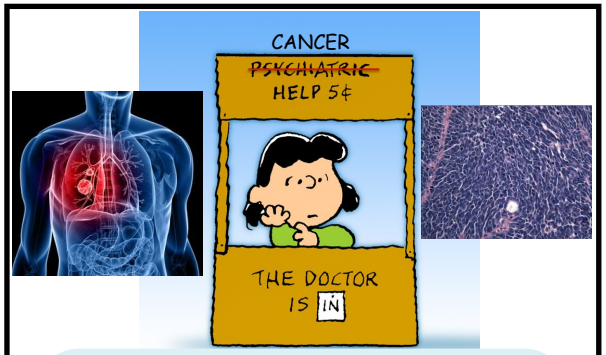
A new educational series designed to bridge the Biology/Engineering divide

Modeling Cancer in the Mouse: The Basics



by David Feldser
Jacks Lab

Wednesday, July 25, 3 PM
76-156 (KI auditorium)



THE DOCTOR IS IN

THIS MONTH:
SMALL CELL LUNG CANCER

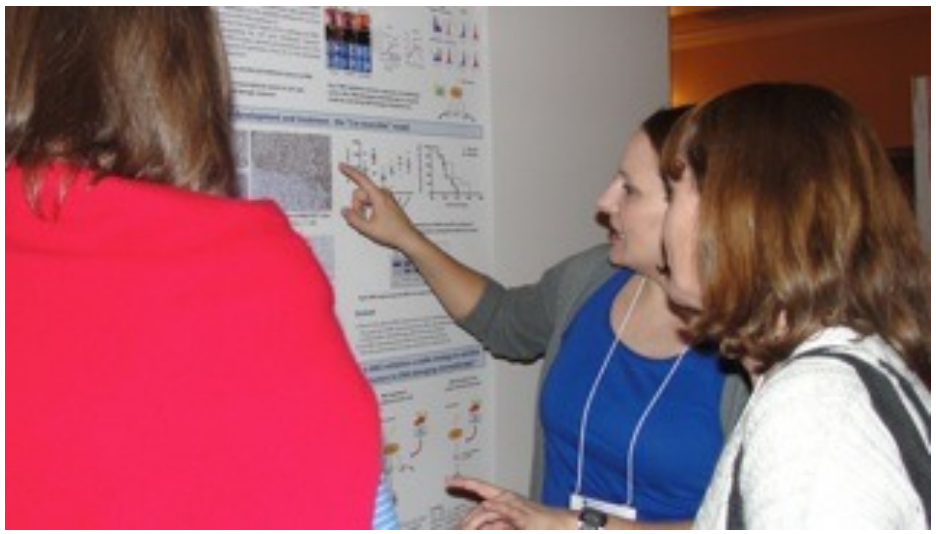
Join us to learn more about diagnosis, staging, and treatment in the *clinical* management of small cell lung cancer.

WEDNESDAY
December 19, 4 PM
KOCH INSTITUTE CONFERENCE ROOM 76-156

Hosted by KI physician-scientist Anna Farago

ENGINEERING GENIUS BAR

The 2012 Koch Institute Retreat



Clinical

Industrial

MIT
Science &
Engineering

Government

KOCH INSTITUTE
for Integrative Cancer Research at MIT

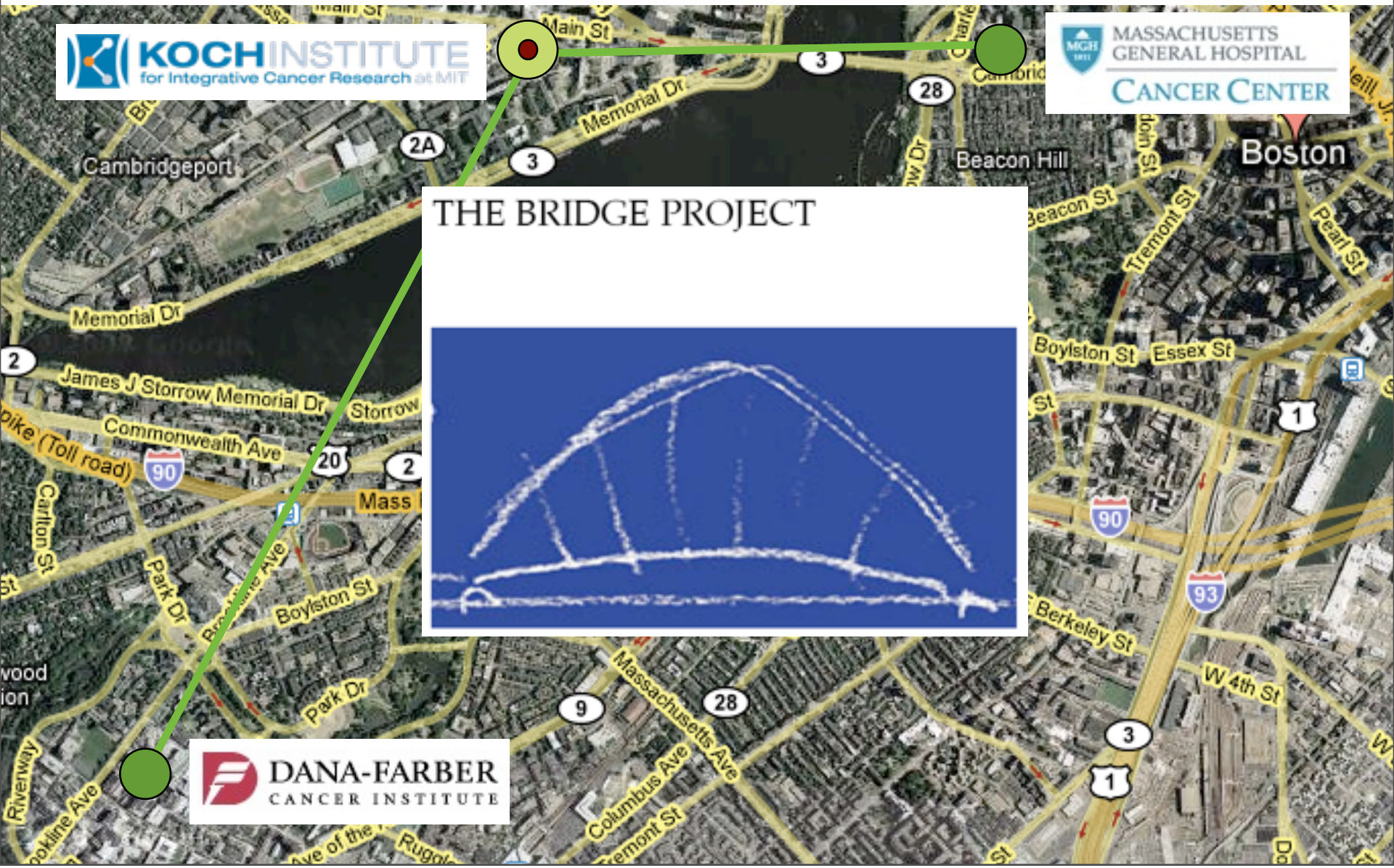
Koch Institute Clinical Investigator: Physician Scientist

Scott Floyd, MD, PhD
Koch Clinical Investigator
Brain Cancer Genetics and Treatment
Instructor, BI Deaconess, Radiation Oncology

ctivity in clinical, translational, and basic research is essential. The
ed individuals will have dedicated lab space and research support
and will work closely with faculty mentors at the new Koch Institute.

Alice Shaw, MD, PhD
Koch Clinical Investigator
Lung cancer genetics and treatment
Assistant Professor, MGH Thoracic Oncology Center

Enhancing Clinical Partnerships



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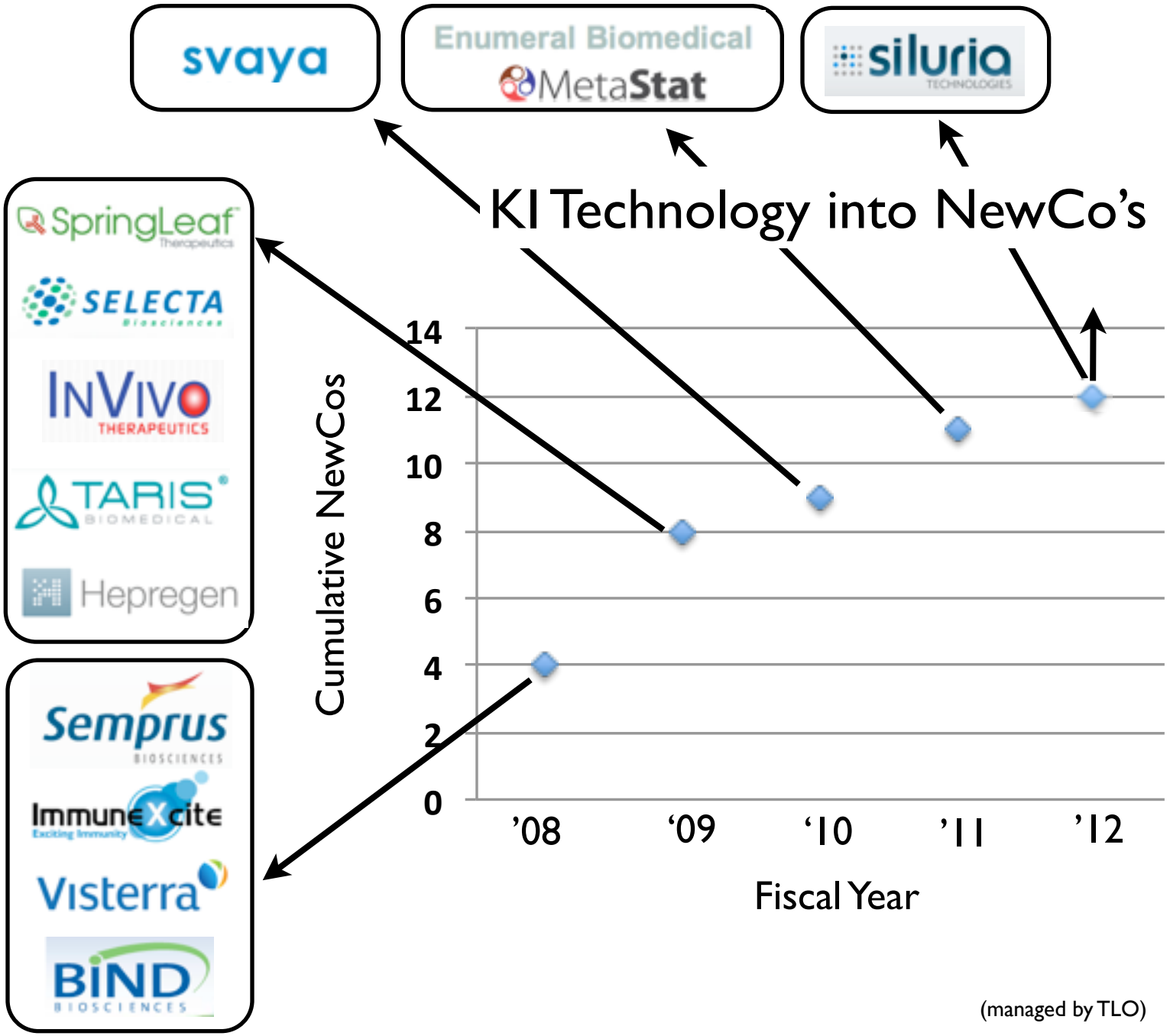
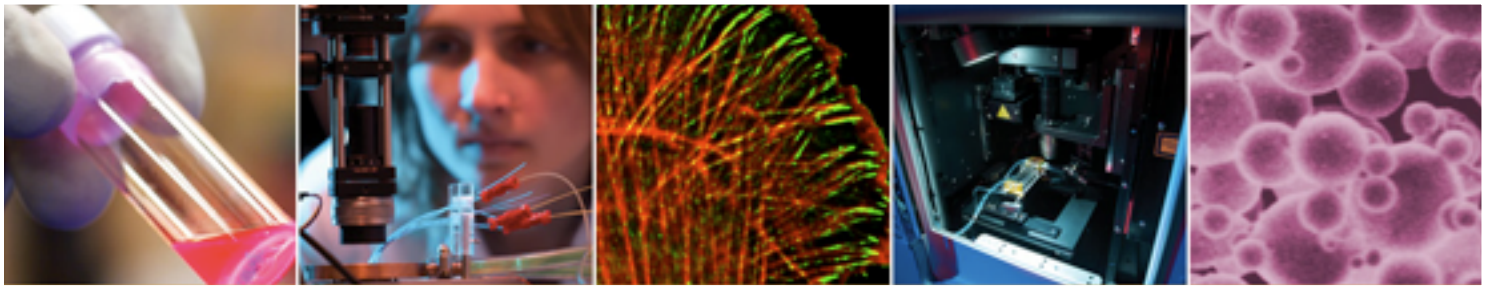
- Product And Operating Company News

Ortho-McNeil-Janssen Pharmaceuticals, Inc. Announces Oncology Research Collaboration Agreement with the Koch Institute for Integrative Cancer Research at MIT


svaya
Enumeral Biomedical
MetaStat
siluria
TECHNOLOGIES
KI Technology into NewCo's
SpringLeaf
Therapeutics
SELECTA
Biosciences
INVIVO
THERAPEUTICS
TARIS
BIOMEDICAL
Hepregen
Semprus
BIOSCIENCES
ImmuneXcite
Exciting Immunity
Visterra
BIND
BIOSCIENCES
Cumulative NewCos
14
12
10
8
6
4
2
0
'08
'09
'10
'11
'12
Fiscal Year
(managed by TLO)

Priority Research Areas



1 Nano therapeutics

2 Devices & Monitoring

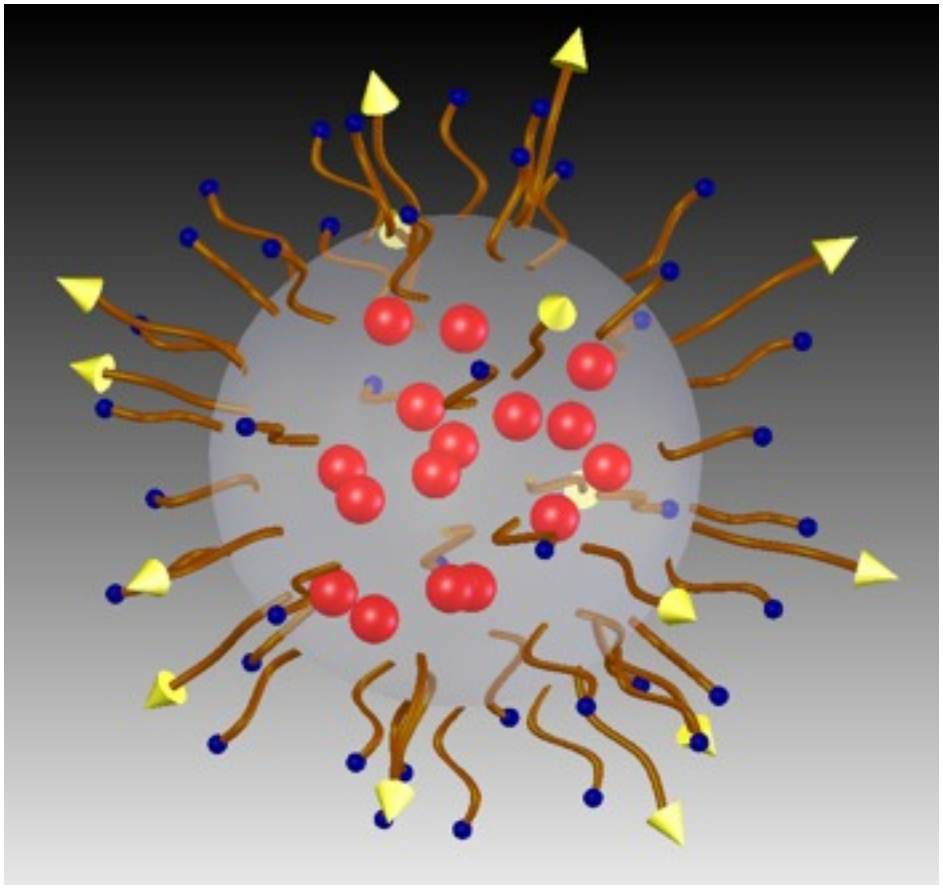
3 Metastasis

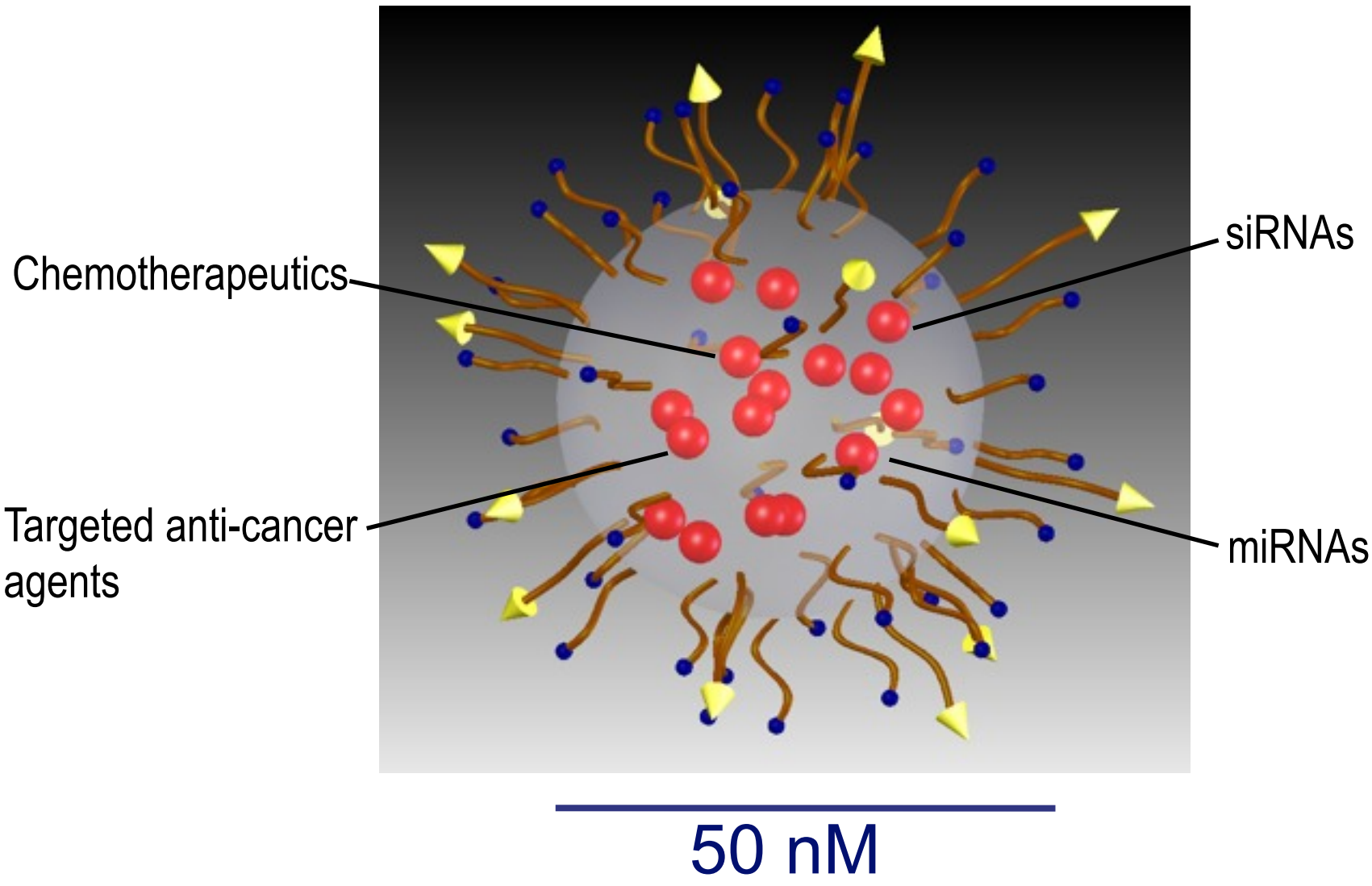
4 Personalized Cancer Medicine

5 Cancer Immunology


Robert Langer
© Stu Rosner Photography

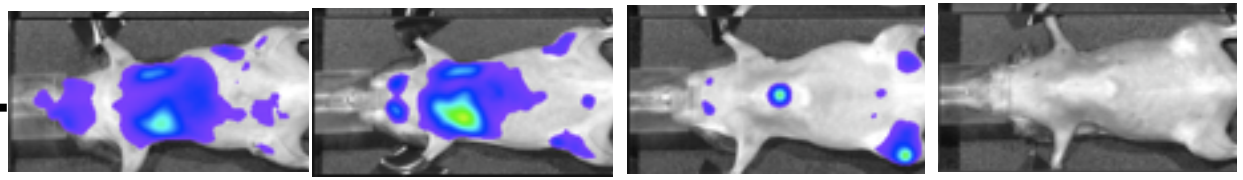

BIND
BIOSCIENCES
Targeting Disease
with Accurins™


50 nM


Chemotherapeutics
siRNAs
Targeted anti-cancer agents
miRNAs
50 nM

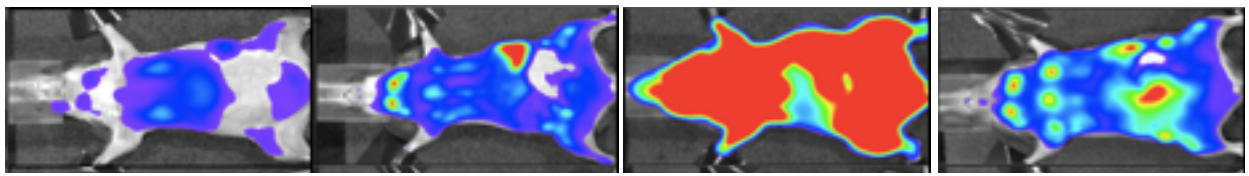
Engineering the Immune System to Fight Cancer

Unmodified tumor-reactive T-cells

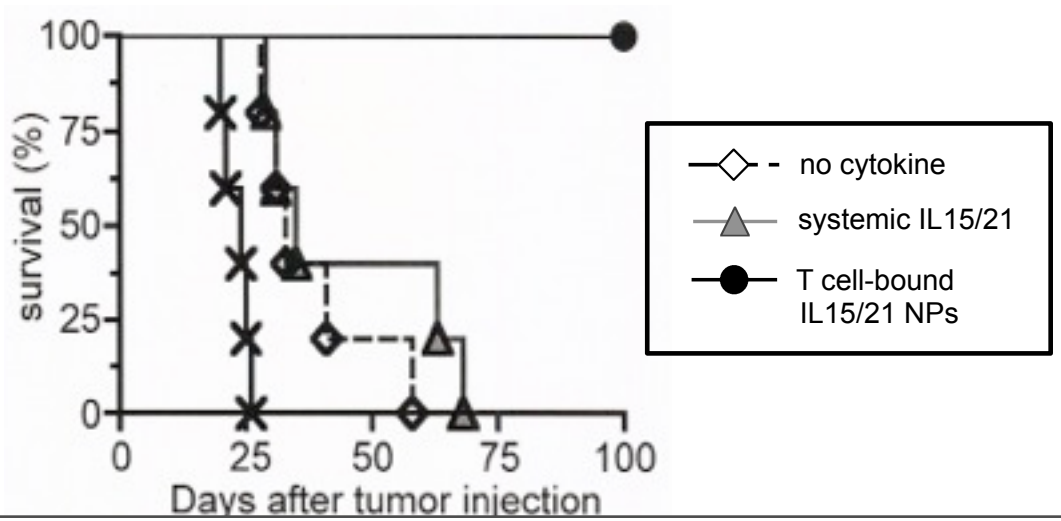


day 0 day 2 day 4 day 14

Nanoparticle-conjugated tumor-reactive T-cells

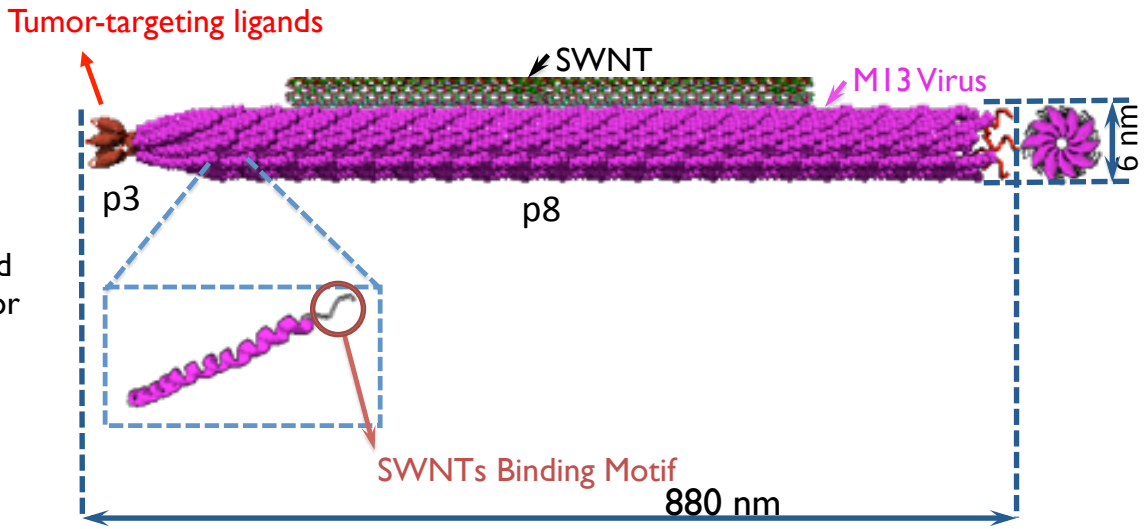


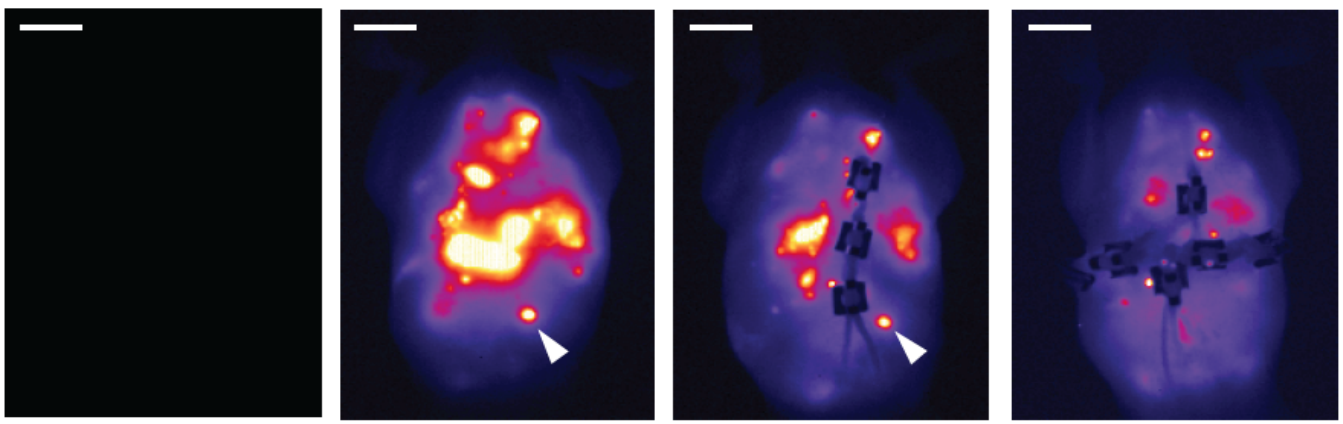
Darrell Irvine



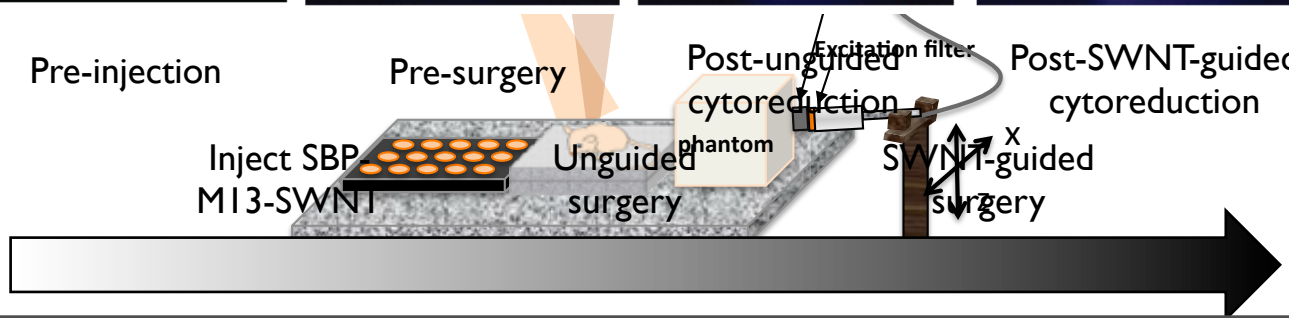
Novel cancer imaging strategies

M13 phage-stabilized single-walled carbon nanotube imaging probe for NIR II fluorescence imaging

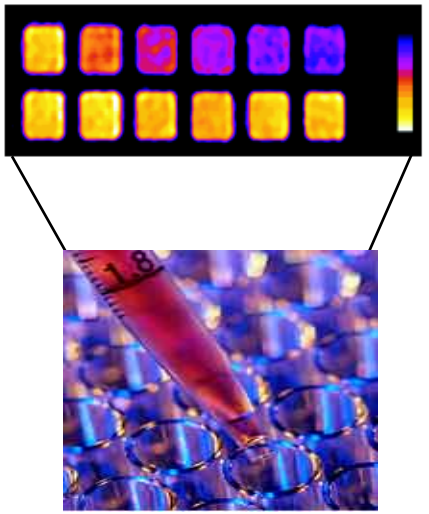


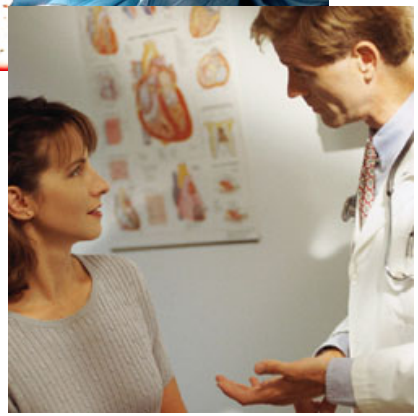


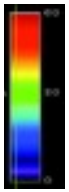
Angela Belcher

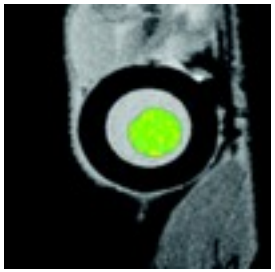


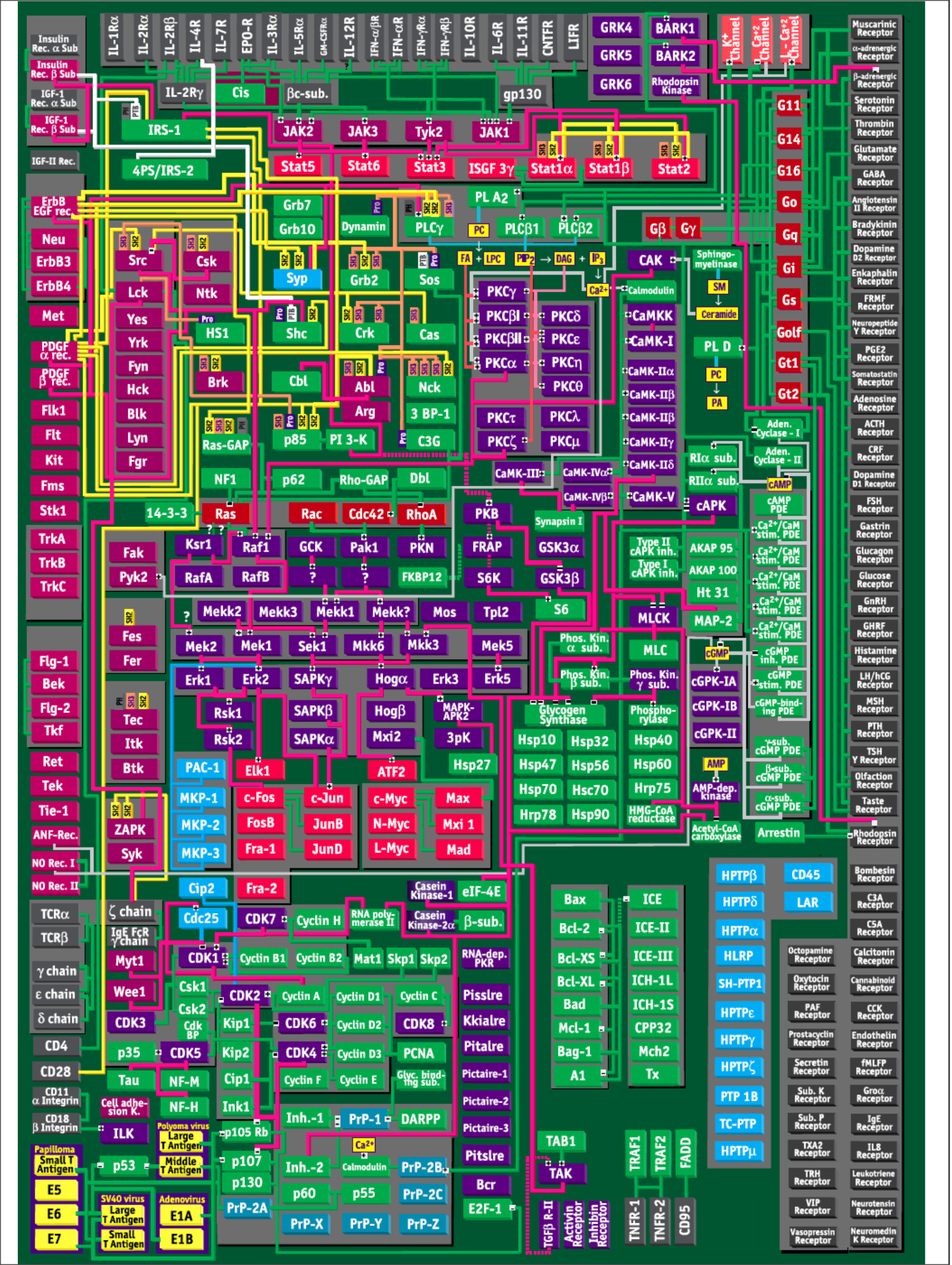
Engineer implantable devices to monitor and treat cancer



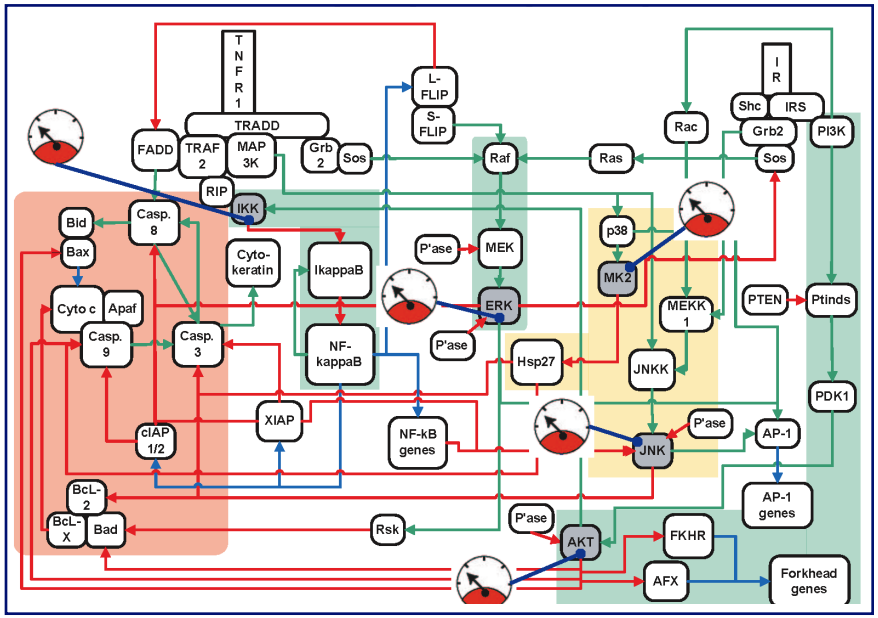


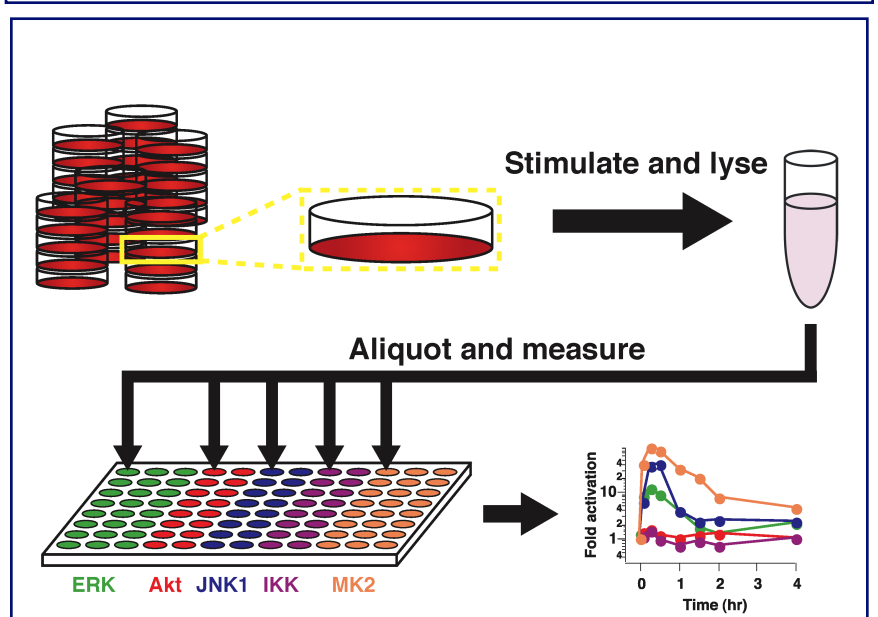






Systematic analysis of cancer networks





$$\frac{1}{k_{off}}\frac{d\bar{R}}{dt} = -\bar{R}\frac{G_1\bar{P}_a + Da\bar{C}}{1+Da\bar{R}} + \gamma(1-\bar{R}) + \bar{C}$$

$$\frac{1}{k_{off}}\frac{d\bar{C}}{dt} = \bar{R}\frac{G_1\bar{P}_a + Da\bar{C}}{1+Da\bar{R}} - \frac{\bar{C}}{1-\delta}$$

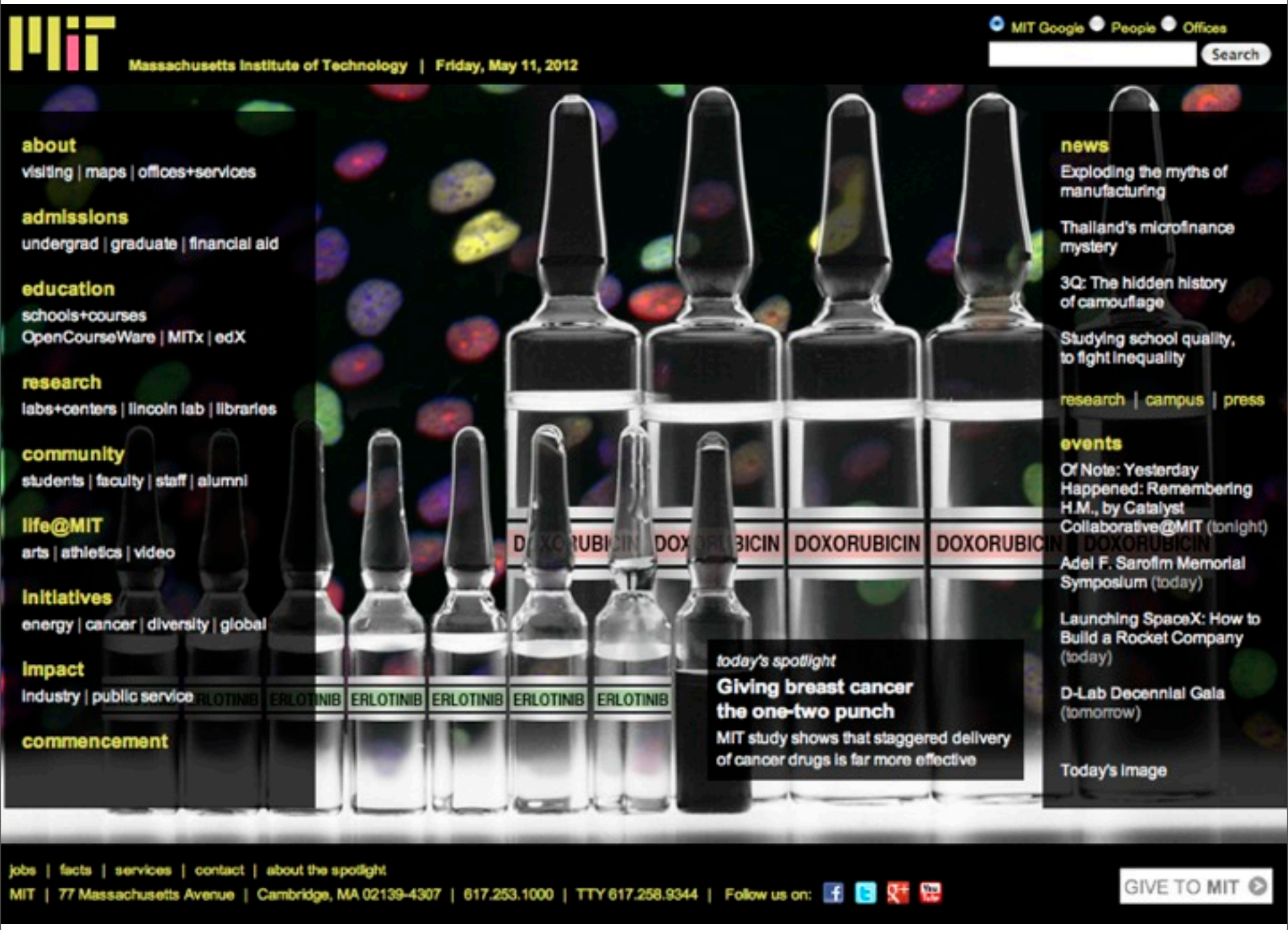
$$\frac{de_{1p}}{dt} = \frac{I_0 + G_2R_T\bar{C}}{1+G_4e_{3p}}\frac{1-e_{1p}}{K_{m,1}+(1-e_{1p})} - \frac{V_{\max,3}e_{1p}}{K_{m,3}+e_{1p}}$$

$$\frac{de_{2p}}{dt} = \frac{k_2e_{1p}(1-e_{2p})}{K_{m,2}+(1-e_{2p})} - \frac{V_{\max,4}e_{2p}}{K_{m,4}+e_{2p}}$$

$$\frac{de_{3p}}{dt} = \frac{k_3e_{2p}(1-e_{3p})}{K_{m,3}+(1-e_{3p})} - \frac{V_{\max,6}e_{3p}}{K_{m,6}+e_{3p}}$$

$$\frac{1}{k_e^P}\frac{d\bar{P}}{dt} = \mu(1-\bar{P}) - (\nu_0 + G_3e_{3p})\bar{P}$$

$$\frac{1}{k_e^P}\frac{d\bar{P}_a}{dt} = (\nu_0 + G_3e_{3p})\bar{P} - \bar{P}_a$$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admissions
undergrad | graduate | financial aid
education
schools+courses
OpenCourseWare | MITx | edX
research
labs+centers | lincoln lab | libraries
community
students | faculty | staff | alumni
life@MIT
arts | athletics | video
initiatives
energy | cancer | diversity | global
impact
industry | public service
commencement
DOXORUBICIN
ERLOTINIB
today's spotlight
Giving breast cancer the one-two punch
MIT study shows that staggered delivery of cancer drugs is far more effective
news
Exploding the myths of manufacturing
Thailand's microfinance mystery
3Q: The hidden history of camouflage
Studying school quality, to fight inequality
research | campus | press
events
Of Note: Yesterday Happened: Remembering H.M., by Catalyst Collaborative@MIT (tonight)
Adel F. Sarofim Memorial Symposium (today)
Launching SpaceX: How to Build a Rocket Company (today)
D-Lab Decennial Gala (tomorrow)
Today's image
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for Integrative Cancer Research at MIT

science + engineering...conquering cancer together

PEOPLE RESEARCH APPROACH NEWS + EVENTS SWANSON BIOTECHNOLOGY CENTER SUPPORT