

Creating Futures

University of Colorado *at Boulder*



The Colorado Initiative in Molecular Biotechnology

A Dynamic New Approach to Discovery





“While the central goal of this new institute is to spark discovery research, it will have an impact on education as well. The most vibrant science education experience research universities can foster comes not from classroom teaching, but when undergraduates enter research laboratories. This is where they get personalized education. They work with state-of-the-art equipment on questions whose answers are not yet known. Those experiences are the ones students remember five and ten years after they have left the university. That is what transforms their lives.”

**–Dr. Thomas Cech, Nobel Laureate
Former President, Howard Hughes Medical Institute
Faculty member, University of Colorado at Boulder,
Department of Chemistry and Biochemistry**

Advancing Breakthrough Discoveries With Widespread Impact

The Colorado Initiative in Molecular Biotechnology is home to a team of world-class scholars and outstanding students dedicated to solving the most challenging problems in human health.

Here at the University of Colorado, amazing research and discoveries have already resulted in remarkable breakthroughs—advances that are paving the way for medical applications that were once unimaginable.

Just imagine:

Personalized Drug Therapies that Maximize Effectiveness

Researchers in chemistry, genetics, and medical sciences are finding the linkages between genes and different medicines to help physicians determine the best treatment for you. A new approach known as personalized therapy promises greater effectiveness while minimizing the risk of side effects.

Synthetic Cartilage that Prevents Knee or Hip Replacement Surgery

Engineers and biologists, in collaboration with surgeons at the Anschutz Medical Campus, are developing therapies that could eliminate the need for synthetic implants in joints by applying newly discovered cell therapies that can re-grow cartilage.

Early Detection of Metastasized Cancers

Our scientists have integrated chemistry, biology, and genetics to develop technologies that determine whether a cancer will spread to other areas of the body, including melanoma, breast, lung, and prostate cancers. Now we're developing tests that physicians can use to choose the best possible treatment at the earliest stages of the disease.



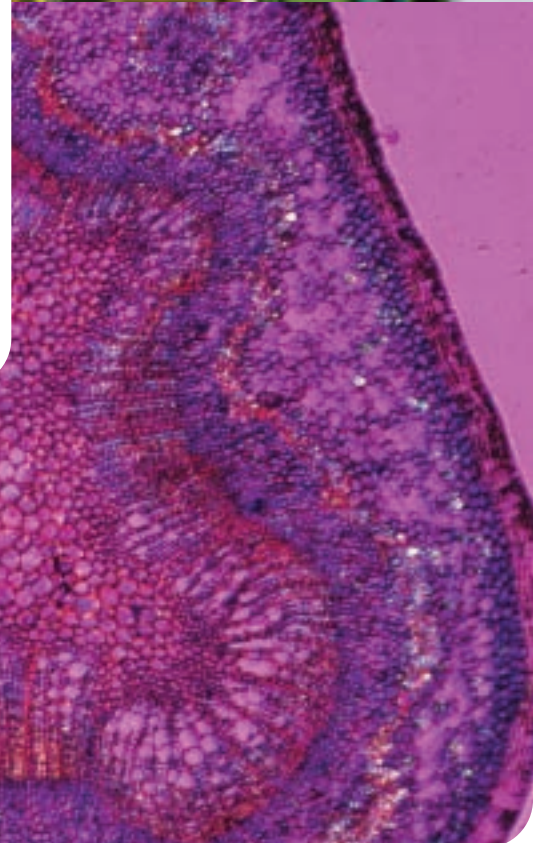


The Promise of New Discoveries With Your Support

Emerging insights into the molecular structure and systems of the human cell are sparking new discoveries. Our scientists are poised to make more extraordinary breakthroughs on many fronts, including:

- The engineering of synthetic human tissues
- The creation of sensors that detect cancer and other diseases at earlier stages
- The genetic makeup of complex diseases
- The development of new pharmaceuticals

You can help make these and many other life-changing developments a reality by investing in the University of Colorado's pioneering approach to discovery—The Colorado Initiative in Molecular Biotechnology (CIMB).



Leading the Way in Biotechnology

With your support, the University of Colorado has a historic opportunity to achieve major breakthroughs in biotechnology and bioscience. As these industries continue to flourish in Colorado, we can build on our rich heritage of biotech contributions.

We can leverage our status as an education and research leader and continue to attract dynamic talent. With additional funding, we can add to our distinguished faculty, which already includes:

- Four Nobel laureates
- 21 members of the National Academy of Sciences
- Four Howard Hughes Medical Investigators
- Seven MacArthur Fellows

Nobel Prize winner Dr. Thomas Cech has returned to CU-Boulder to resume research and teaching full time. His research team discovered catalytic RNA, which transformed our understanding of how information from DNA is converted into protein sequence, structure, and cellular regulation. The discovery, a surprise to the scientific community, altered the central dogma of the biosciences and led to Dr. Cech's Nobel Prize award. The discovery also led to the founding of Sirna Therapeutics, Inc., now a major drug discovery platform for the pharmaceutical giant Merck & Co. Catalytic RNA technology is leading the way for entirely new strategies for medical therapies and diagnostics.

Building on an Impressive Track Record

- In the past five years, CU-Boulder generated \$60 million in revenue from intellectual property created by its research investigators, the vast majority from biotechnology discoveries.
- 15 biotechnology companies have been created from CU-Boulder's intellectual property.
- The campus attracts more than \$250 million annually in sponsored research awards.
- Our centers for laser spectroscopy and physics are ranked second in the world, in partnership with the National Institute for Standards and Technology.
- We lead the world in nucleic acid research and have key strengths in developmental and cell biology.

Dr. Larry Gold has devoted nearly 40 years to the university as a faculty member and (from 1988 to 1992) as chair of the molecular, cellular, and developmental biology department. During his distinguished career, Dr. Gold also became a biotechnology industry pioneer, acting as founder or co-founder of successful companies including Synergen, Inc., NeXagen, Inc., and SomaLogic, Inc. A drug Dr. Gold developed for macular degeneration, Macugen®, generated significant royalties, some of which Dr. Gold generously gifted to the CIMB. This \$7.5 million unrestricted program gift allows the leadership to nimbly respond to new opportunities and deploy resources where needed most.

“With increased investment in people and resources, we can move biotechnology research and applications to new heights.”



–CU-Boulder Chancellor
Philip DiStefano

A New Approach to Creative Invention

The **Colorado Initiative in Molecular Biotechnology (CIMB)** is addressing urgent needs in vaccine development, cardiovascular health, tissue replacement, drug discovery, and human diseases. Our scientists are working at the interface of biology, chemistry, physics, mathematics, and engineering to discover new tools to probe and manipulate cells on a molecular level.

Our approach is based on a simple, yet pioneering formula:

- Build bridges between academic disciplines, departments, and colleges to create a unique synergy that transcends traditional research boundaries.
- Combine strategic partnerships and access to the best technology to yield new ideas and accelerate the discovery and research application process.

A Gift that Marries History With Opportunity

Jack and Jeannie Thompson's ties to the University of Colorado run deep. In addition to receiving their undergraduate degrees from CU-Boulder, their love story started "on the Hill" at the legendary Sink restaurant. Over time, the emotional tie to CU deepened.

As Jack reflects, "CU served as a bookend for us. It was there for us before I went to Vietnam, and it was there for us after I returned home from the war."

In return, the Thompsons have been there for CU. As volunteers and donors to programs across the university, their philanthropy brought the enormous personal satisfaction that comes from getting involved and having an impact. Now, in Jeannie's role as chair of the CU Foundation Board of Directors, she and Jack have been considering what new area of the university they'd like to support.

After graduating from CU, Jeannie spent 12 years working in research labs for the National Institutes of Health, the University of Colorado Hospital, and the University of Michigan School of Public Health. In each, she learned firsthand the critical importance of research, discovery, and vaccine development.

Reflecting their own early interests, they decided to help build a new vaccine lab for the Colorado Bioscience Initiative. The Jean L. and Jack C. Thompson Vaccine Development Laboratory will be housed in the Jennie Smoly Caruthers Biotechnology Building, scheduled for groundbreaking in summer 2009.



Jack and Jeannie Thompson

"This is a terrific opportunity for us to step forward and fund something that is important to the university, Colorado, and the world," says Jeannie. "We're excited about supporting an area that's personally meaningful and also holds so much potential."

Their \$2 million gift cements an enduring commitment to groundbreaking research and educational excellence.

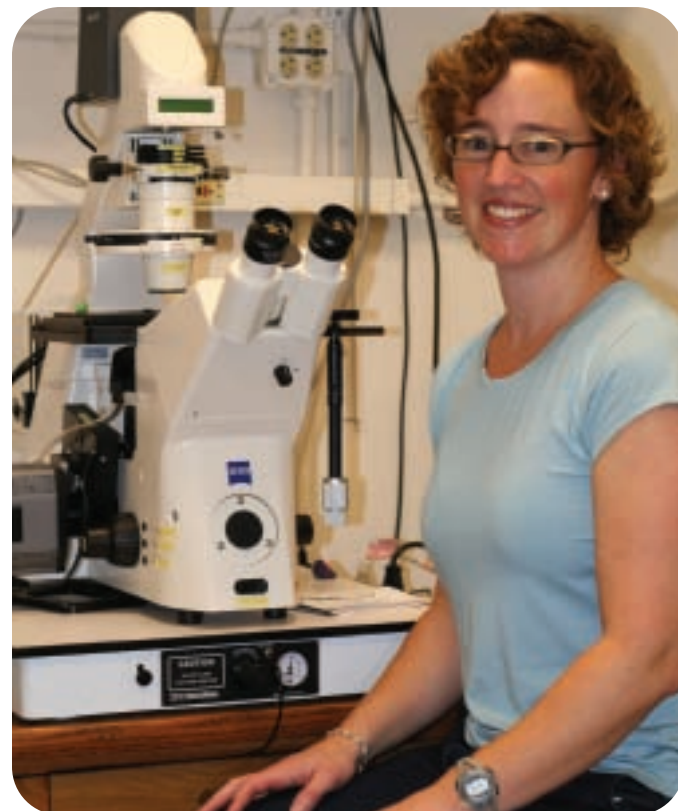
Collaboration Breeds Innovation

Dr. Theodore Randolph, Gillespie Professor of Bioengineering and Co-Director of the Center for Pharmaceutical Biotechnology, is using his expertise in protein stabilization to develop new vaccines for botulism and other potential bio-terror diseases, along with common diseases such as measles. His group is developing inhalable vaccines in partnership with researchers from chemistry and biochemistry, medical researchers at the Anschutz Medical Campus, and scientists at AKTIV-DRY, a spinoff company formed by University of Colorado professors to commercialize innovations in particle synthesis and coating.

Inhalable vaccines can be stored without refrigeration. Imagine the impact in developing countries, where the availability of vaccines that don't require refrigeration will allow patients greater access to lifesaving medications.

CIMB is, at heart, a grassroots initiative launched by faculty and students who are demanding access to cutting-edge practices in scientific research to achieve positive outcomes quickly and efficiently. They are working together toward a common goal and have developed:

- Stronger interactions between scientific fields
- New mechanisms for collaborative research and funding opportunities
- Innovations in cross-disciplinary teaching
- Top-of-the-line shared instrument facilities



“We know that ideas don't generate in isolation. If we want to make big progress in science and the nature of disease, we must bring together the right people.”

—Dr. Amy Palmer, Assistant Professor,
Department of Chemistry and Biochemistry



Dr. Natalie Ahn, Associate Professor, Department of Chemistry and Biochemistry, Co-Director, Colorado Initiative in Molecular Biotechnology

Dr. Natalie Ahn's team is investigating melanoma as a model for cancer progression by researching the signaling pathways of melanoma cells. This requires interactions with physical chemists, computational scientists, cell biologists, and medical clinicians. CIMB's interdisciplinary approach facilitates these interactions and helps generate ideas.

Extraordinary People Charting New Frontiers

CIMB is creating a new scientific paradigm by strategically investing in people across academic disciplines, free of the traditional constraints of a silo-based university research model. We are recruiting the most talented scientists at the interface of life science, physical science, and engineering.

This growing team has a demonstrated commitment to collaboration, a dedication to excellence in teaching, and the capacity to attract significant research dollars. We are setting a new standard for what a university can do to achieve bioscience breakthroughs that result in medical application.

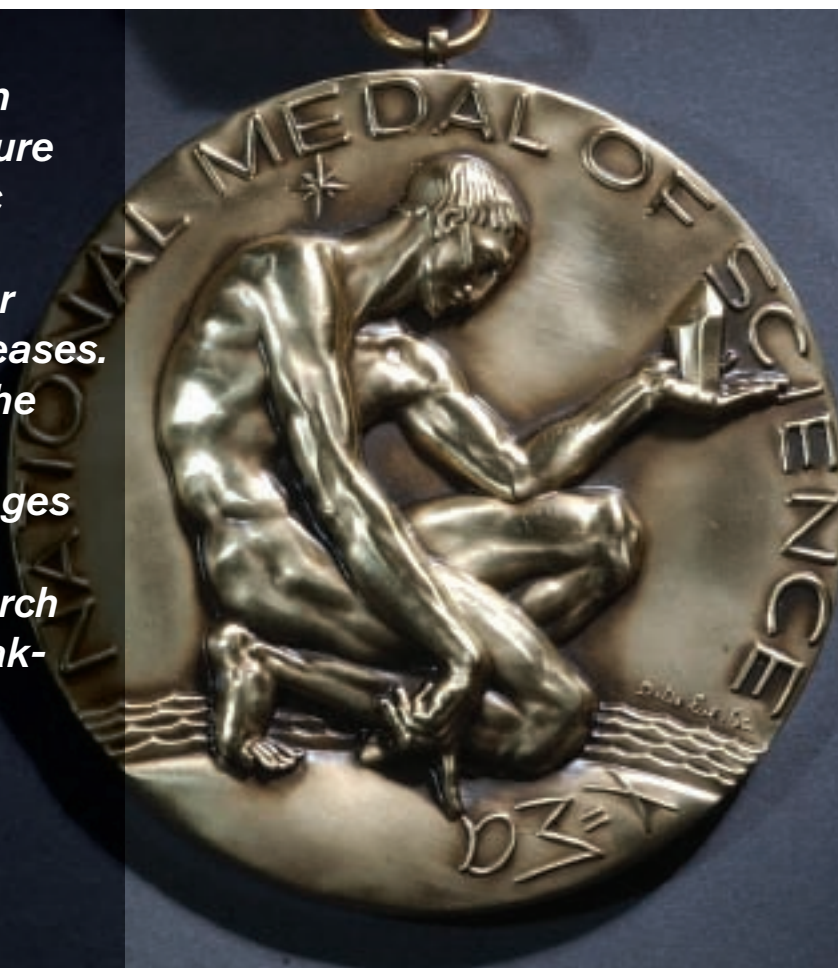
Dr. Marvin Caruthers, professor in the Department of Chemistry and Biochemistry, has conducted groundbreaking work on technologies for the rapid synthesis of DNA and RNA. This, in turn, has fueled modern biotechnology by enabling genome sequencing, gene isolation, and diagnosis of diseases using DNA chips.

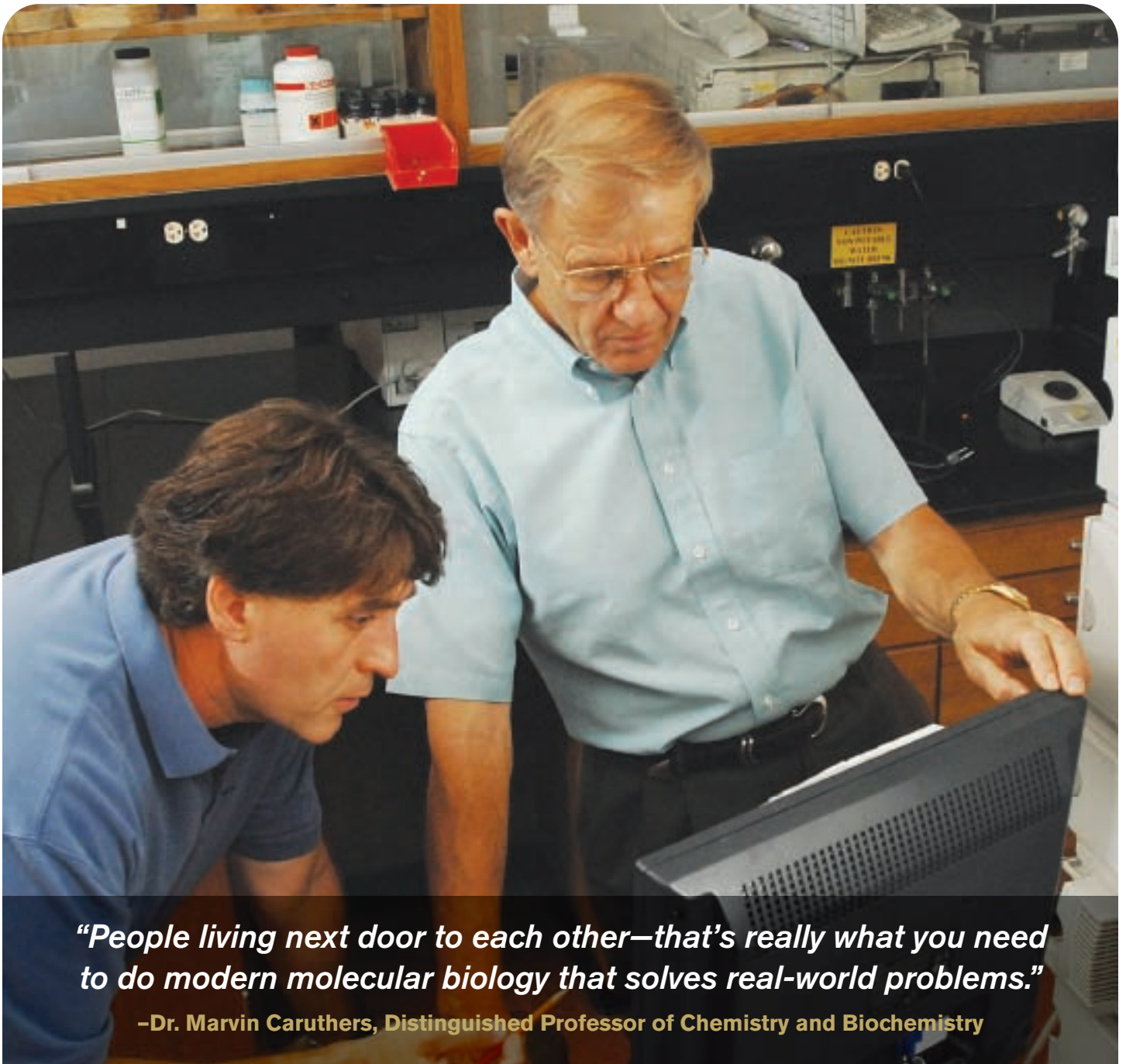


Dr. Caruthers co-founded Applied Biosystems, which markets “gene machines” for the rapid analysis of genetic material, and Amgen, which produces protein-based therapeutics and employs more than 10,000 people worldwide. For these contributions, Dr. Caruthers was awarded the prestigious National Medal of Science.

“We can mend broken bones, but we can’t cure cancer. New scientific paradigms must be discovered to cure our most challenging diseases. It’s gratifying to see the university invest in an initiative that encourages collaboration and the kind of exciting research that can result in breakthrough discoveries.”

**–Dr. Marvin Caruthers,
Professor, Department of
Chemistry and Biochemistry,
and 2006 National Medal
of Science Recipient**





“People living next door to each other—that’s really what you need to do modern molecular biology that solves real-world problems.”

–Dr. Marvin Caruthers, Distinguished Professor of Chemistry and Biochemistry

Dr. Marvin Caruthers: A Lifetime of Science and Sharing

Dr. Marvin Caruthers (pictured, above right) is a biotechnology pioneer. With a passion for solving complex problems, he has personally witnessed breakthrough discoveries from biotech research.

That’s why he decided to invest his personal resources to advance the Colorado Initiative in Molecular Biotechnology (CIMB). At the heart of CIMB will be the Jennie Smoly Caruthers Biotechnology Building, named in honor of Dr. Caruthers’ late wife, a legacy that reflects the spirit of their shared passion for collaborative research.

Dr. Caruthers’ lead gift, the largest ever given to CU-Boulder by a faculty member, will bring their vision to reality. The new building will be home to a center where physicists will lunch with biologists, mathematicians will occupy offices next to chemists, and students will learn about cell signaling, prosthetics design, and the physics of the heart.

Research Designed to Address Pressing Human Needs: Imagine the Possibilities

Flu Diagnostics—Chemistry and biochemistry laboratories led by Drs. Kathy Rowlen, Robert Kuchta, and seven other investigators are working together to create a revolutionary tool for medical diagnostics. The “flu chip” is being designed to quickly and accurately diagnose human and avian flu strains. This kind of diagnostic technology is especially vital in areas of the world where basic scientific capabilities to track, monitor, and treat disease are severely limited.

Tissue Replacement Technologies—Dr. Kristi Anseth, distinguished professor of chemical and biological engineering, is the Howard Hughes Medical Institute’s first-ever engineering investigator. She is working with Dr. Leslie Leinwand and a surgical group at the Anschutz Medical Campus to engineer living human tissues. Her team was the first to successfully develop an injectable, biodegradable “scaffold” to regenerate cartilaginous tissue, and it is now working to engineer a replacement heart valve.

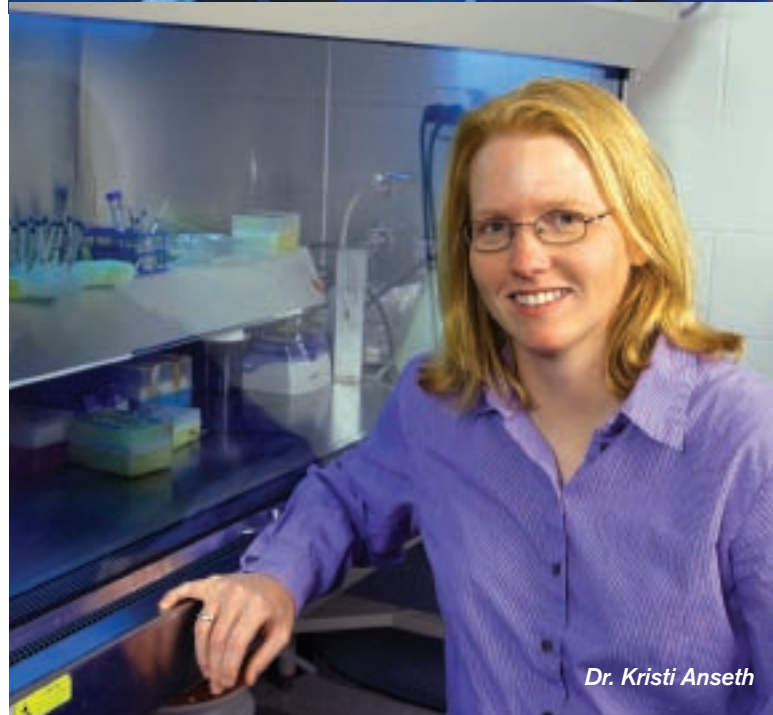
New and More Accessible Vaccines—Dr. Robert Garcea is using state-of-the-art microscopy to generate images of single virus particles, which is leading to breakthroughs in vaccine development for pathogens like the Human Papilloma Virus (HPV). Dr. Garcea is building collaborations with scientists across the University of Colorado System, in the corporate sector, and among the entire Colorado research base to accelerate virology discovery, much of it under the auspices of grants from the Bill and Melinda Gates Foundation.

“We are creating a community of top researchers who will pool their expertise to make new discoveries that have tremendous potential—like tissue regeneration and biomarkers.”

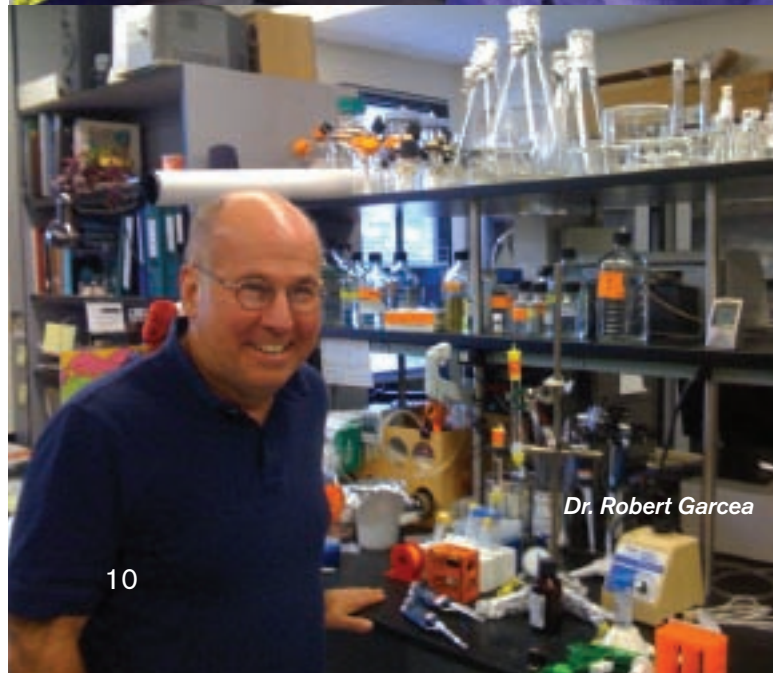
—Dr. Leslie Leinwand, CIMB Director



*Dr. Kathy Rowlen
and Dr. Robert Kuchta*



Dr. Kristi Anseth



Dr. Robert Garcea

A Major Contributor to Colorado's Economic Vitality

Robust biotechnology business development is driven by science and education. Colorado is already home to one of the most advanced, fastest-growing life science industry clusters in the United States. With 16,000 employees in 400 companies today in Colorado, the industry is on track to generate 34,000 jobs at an average salary of \$63,000 and provide an overall \$6.3 billion economic impact on the state by 2010.

CIMB is at the center of a growing biotechnology infrastructure that supports regional, national, and global competitiveness in a knowledge-based economy. Future research will add to the growing number of high-tech, high-wage jobs that are critical to Colorado's economic growth and to our scientific leadership in biotechnology.

Biochemist Dr. Bruce Eaton and biologist Dr. Larry Gold are pioneering innovative approaches to synthesize complex "libraries" of RNA and DNA, which are expanding the chemistries available for finding new drug families. Their inventions have driven the development of six biotech companies, including Synergen, NeXstar, and SomaLogic, Inc.

Successful Companies Started With University of Colorado Technology

- Amgen
- Applied Biosystems
- Array BioPharma
- Dharmacon
- Myogen, Inc.—bought by Gilead Sciences, Inc. for \$2.5 billion in 2006
- NeXstar Pharmaceuticals, Inc.—bought by Gilead Sciences, Inc. for \$500 million in 1999
- Sirna Therapeutics, Inc.—bought by Merck & Co., Inc. for \$1.1 billion in 2006

Spawning New Biomedical Companies

Dr. Leslie Leinwand, professor in the department of molecular, cellular, and developmental biology and director of CIMB, is widely recognized for the development of transgenic mouse models for severe genetic heart disease. Her work with Dr. Michael Bristow, professor of medicine at the University of Colorado Denver, generated the successful startup company Myogen Inc., a biopharmaceutical company focused on discovery, development, and commercialization of small-molecule therapeutics for the treatment of cardiovascular disorders. Myogen was recently purchased by Gilead Sciences, Inc. for \$2.5 billion.



A photograph of two scientists in a laboratory. They are wearing white lab coats and safety goggles. The scientist in the foreground is looking down at a piece of equipment, while the one behind him is looking on. The background shows laboratory equipment and a tiled floor.

Preparing Tomorrow's Biotechnology Innovators for a Complex World

The world does not operate in silos. Nor should our approach to understanding it. Undergraduate and graduate students are benefiting from a growing selection of bioscience courses that cross disciplines. Working side-by-side with leading scholars in multiple fields, they have access to the latest innovations and technologies.

The students will enter the workforce fully prepared for interdisciplinary interactions, with strong entrepreneurial skills valued by small companies and startups and an education that has fostered extraordinary responsiveness, curiosity, and breadth.

"I really want to do something that is useful that can advance our understanding of disease. Education is the key to this. People are the main resource and we must teach them state-of-the-art techniques and prepare them ready to enter the biotechnology workforce."

**–Dr. Hubert Yin, Assistant Professor,
Department of Chemistry and Biochemistry**

Bringing Science Alive for Students of All Ages

CIMB is also addressing the biotechnology talent pipeline in elementary and secondary schools in our state. The Biological Sciences Initiative connects University of Colorado faculty and graduate students with more than 350 middle and high school teachers along the Colorado Front Range to equip them with skills to engage more than 15,000 students in exciting science activities.

CU's community outreach initiatives, CU Science Discovery and the CU Wizards program, engage children and families in exciting science experiences. Filling an important niche in the burgeoning after-school education movement, these programs spark an interest in science and technology in young people.

These are the children that will eventually conduct research in the University of Colorado labs, with the potential to lead the most innovative bioscience companies around the world.

As a former CEO of Myogen, entrepreneur **Bill Freytag** knows that when pursuing new pathways, it's essential to have the best people on board. Inspired by the work of longtime colleague Dr. Leslie Leinwand and the CU return of Professor Tom Cech, Bill and his wife, Janet, made a \$5 million endowed gift to CIMB to support interdisciplinary biotechnology research. "The CIMB is a great way to bring together scholars and students from diverse disciplines to carry out discovery and translational research that addresses the most challenging problems in human health," said the Freytags.



"The potential of bioengineering and medicine is fascinating. Just imagine being able to grow heart tissue out of a Petri dish. The future of medicine is definitely happening here at the University of Colorado."

**–Michael Polmear,
Undergraduate Student,
Department of Chemical
and Biological Engineering**

Second-year engineering student **Michael Polmear** is on track for a MD/PhD specifically because he wants to move things quickly from discovery to clinical application. Before graduating high school, Mike was featured on ABC's Good Morning America for his development, in collaboration with Dr. Brian Tseng, of a polymer sealant to repair the membrane tears that lead to the muscle degradation in Duchenne Muscular Dystrophy. He is now working with CIMB mentors to understand the cellular mechanism and integrated physiology of how muscles adapt to injury.

Like many of our talented students, Mike receives donor-funded scholarship support. The aid is critical to attracting and retaining brilliant students poised to make notable contributions in their areas of interest and growing expertise.

Seed Grants Set to Spark Collaboration Among CU's Top Researchers

Jane and Charles Butcher's tradition of community involvement and firm belief in social responsibility set the stage for their philanthropic contributions. In fact, a guiding principle stemmed from Charles's lifelong admiration for Jewish scholar Rabbi Hillel, who said, "If I am not for myself, then who will be for me? And if I am only for myself, then what am I? And if not now, when?"

Translating principle to action, the Butchers have made a series of major gifts to CU. Most recently, to honor her late husband's interest in biotechnology, Jane Butcher contributed an additional \$1 million gift to fund seed grants for CU's most prominent scientists under the auspices of CIMB. Designed to encourage interdisciplinary collaboration, Jane hopes the grants will lead to breakthrough discoveries in the emerging field of molecular biotechnology.

Former CU-Boulder Chancellor G.P. "Bud" Peterson, a staunch supporter of the Butchers' vision, has matched the gift and doubled its impact.



Charles and Jane Butcher

"Charlie wanted to turn big ideas into reality. Supporting the work of new, collaborative teams of the best and brightest scientists with the potential for impacting lives far into the future is what he always wanted."

-Jane Butcher

Investing in the Future of Bioscience

The potential for creative synergy among faculty, students, and biotech entrepreneurs requires a flexible and collaborative work space. Currently, CIMB faculty and research are housed in five different buildings. Our growth in faculty and students will far exceed our current lab and classroom space, requiring new, state-of-the-art facilities to realize our dreams.

A New Home to Promote Academic Excellence and Research Breakthroughs

The future success of CIMB is tied to our plan for a new biotechnology building. Anchoring a new East Campus at the site of the CU-Boulder Research Park at 30th Street and Colorado Avenue, the building will bring together more than 60 faculty, including 20 new faculty hires, and 1,200 students.

Designed to facilitate interdisciplinary research, the 260,000 square-foot building purposely breaks down departmental and research silos to promote integration of scientific research. New flexible teaching laboratories

for chemistry, biochemistry, molecular biology, physics, applied mathematics, computer science, and chemical and biological engineering will be housed together. This infrastructure will support current and emerging interdisciplinary degree programs.

Students will collaborate with researchers, biotech entrepreneurs, and corporate partners in a dynamic and stimulating environment. With an auditorium for large conferences and classes, small seminar rooms, computer labs, and teaching labs, the building will have a strong educational focus. Even building amenities such as open meeting areas, a café, and conference rooms organized around an interior “main street” concept are designed to become a crossroads of creativity for students, faculty, and industry members.

Most importantly, the Jennie Smoly Caruthers Biotechnology Building will facilitate conceptual leaps toward new discoveries in biotechnology.



Groundbreaking for the Jennie Smoly Caruthers Biotechnology Building is scheduled for July 2009.



The Time is Now!

To learn about the many ways you can make a gift:

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The Colorado Initiative in Molecular Biotechnology is attracting the most talented researchers, brightest students, and forward-thinking investors. Momentum is building. Your investment will hasten our transformation into a dynamic interdisciplinary hub that breeds exciting new models of scientific research and application.

Consider what we've achieved already. And imagine what is possible with your help.

Colorado
University of Colorado at Boulder