

A person wearing a white lab coat is holding a metal rack containing several test tubes filled with a yellow liquid. The background is a bright, slightly blurred laboratory setting. The text is overlaid on the right side of the image.

Biomedical leader.

UC develops medical treatments, helps create biomedical companies and makes life healthier for millions of people.

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Partnership

While a broad range of federal agencies support UC's biomedical research, much is funded by the National Institutes of Health (NIH). In 2011, UC received \$2 billion from the NIH, helping make California the leading NIH funding recipient across all 50 states. UCSF alone received \$532 million, tops among public institutions in the country. The UC and NIH partnership finds tomorrow's cures and fuels California's biomedical industry.

Industry

The modern biotechnology industry is rooted in UC research.

Since 1976, UC discoveries have spawned nearly 600 startup companies, including biomedical firms that turn out medicines and treatments for a variety of diseases.

More than 1,000 California biotech and other high-tech firms utilize UC research. One-fourth of biotech firms in the U.S. are within 35 miles of a UC campus.

California's more than 2,300 biomedical companies have a total estimated revenue of \$115.4 billion.

In 2010, California biomedical companies employed 267,000 people.



The University of California is a pioneer in medical science, and its discoveries have impacted health care worldwide.

In the 1940s, UC scientists developed the first flu vaccine and discovered good and bad cholesterol. Later, they isolated the insulin gene, which led to mass production of genetically engineered insulin for diabetics. They invented a cochlear implant to help the deaf understand speech and a nicotine patch to help smokers to quit. They pushed MRI technology and saved the lives of babies with a medicine that boosts lung function in premature infants.

UC's biomedical research—much of it funded by NIH—also pumps life into the economy. The biotechnology industry was born from discoveries by UC scientists who co-founded trailblazing companies such as Genentech, Cetus and Chiron. In addition to churning out life-improving treatments for millions of people, these companies and others have provided tens of thousands of jobs in California.

In Good Company

Starting a chain reaction

Discoveries by UCLA researchers launched a company, UroGenesys, to develop drugs for prostate cancer. That fledgling company grew into a robust biotech, the Santa Monica-based Agenesys, which has produced treatments for other cancers. In 2011, the company started construction on a new facility, allowing its workforce to grow 60 percent by 2015. The same UCLA scientists recently started Kite Pharma in Westwood to develop cutting-edge immunotherapies targeted at cancer.

Relief for diabetics

UCSF immunologist Jeffrey Bluestone launched, in collaboration with ViaCyte, a stem-cell based strategy for treating type 1 and some type 2 diabetes. The treatment will help some 10 million Americans who now depend on insulin.

Small start into big things

UC Santa Barbara research gave birth to Cyvenio Biosystems, which creates instruments to diagnose and treat cancer by isolating and purifying critical biomarkers in the blood. Two students formed Sirigen, with offices in San Diego, to develop tools for medical diagnostics. Since its creation in 2003, the company has attracted \$13 million in funding, hired more than 20 employees and introduced its first commercial product.

Forming industry alliances

UC campuses have signed industry alliances with companies including Bayer, Pfizer and Sanofi-Aventis to speed development of drugs to treat cancer, diabetes and other diseases. UCSF and Pfizer are working on experimental therapies to treat conditions including lung and prostate cancer.

Speeding Translations

Turning science into cures

All five UC medical schools (Davis, Irvine, UCLA, San Diego, UCSF) have received federal funding to accelerate the translation of research into cures, as part of a consortium of 60 institutions supported by NIH's Clinical and Translational Science Awards program. The program aims to improve the nation's health through treatments for patients, engaging communities in clinical research and training next-generation researchers.

Institution innovation

The California Institutes for Science and Innovation—a partnership between industry, the state and UC—is a launching pad for new ideas and companies. The four institutes focus on quantitative biosciences (QB3: UCSF, UC Berkeley, UC Santa Cruz), nanosystems (CNSI: UCLA, UC Santa Barbara), telecommunications and information technology (Calit2: UC San Diego, UC Irvine), and IT and society (CITRIS: UC Berkeley, UC Davis, UC Merced, UC Santa Cruz). QB3 brings science and entrepreneurship together to support basic research and move discoveries to commercialization quickly. QB3 has helped launch 65 companies that have raised over \$230 million in capital.

Breaking down barriers

UC's Biomedical Research Acceleration Integration and Development (BRAID) program brings together expertise from the UC Office of the President and the five UC medical school campuses to catalyze change and reduce barriers to biomedical research. Its UC Research Exchange (REX) consortium is developing the first-ever, cross-campus searchable database of patient-level study data from all UC medical centers.

Advancing Technology

Doing away with dialysis

UCSF bioengineer Shuvo Roy directs a project to build the world's first implantable artificial kidney. His team hopes to eliminate the need for dialysis, which is used by 350,000 Americans. The device could save at least \$15 billion a year in Medicare costs alone.

Creating a cell phone microscope

A groundbreaking imaging technology developed by UCLA engineering professor Aydogan Ozcan can turn a simple cell phone into a powerful microscope with just \$10 in parts. The easy-to-use device has the potential to bring better health care to impoverished and underserved areas of the globe. It can be used to monitor diseases like HIV and malaria and to test water quality in the field after a major disaster.

Empowering patients

At UC Irvine's "eHealth Collaboratory," technologists team with health care providers and patients to develop prototype devices to improve quality of life. They include the "EarTrumpet," a customized hearing-aid application for iPhones; a sensor-laden glove that uses music for dexterity training for people with hand impairments; and the "Wimplifier," a computer-vision system for home telerehabilitation after a stroke.

Engineers provide healthy solutions

UC Santa Barbara's new Center for BioEngineering (CBE) applies expertise in engineering to our understanding of the inner working of biology. One of its goals is a completely automated artificial pancreas that will restore normal lifestyle to people with type 1 diabetes. CBE scientists also develop new tools to diagnose disease and mechanisms for drug delivery.

Analyzing DNA, easily

DNA sequencing is critical to scientists uncovering genetic roots of disease. UC Santa Cruz scientists, funded by the National Human Genome Research Institute, developed technology to analyze DNA strands as they pass through a "nanopore." Oxford Nanopore is taking that technology to the market with a disposable device the size of a USB memory stick. Its low cost, portability and ease of use is designed to make DNA sequencing universally available.

Open sourcing robotic surgery

Medical robotics experts at UC Santa Cruz built seven advanced robotic surgery systems for major medical research labs throughout the nation. By sharing the systems, researchers hope to advance the field faster. Robotic surgery could enable new, less-invasive surgical procedures. Telesurgery could provide better access to expert care in remote areas and the developing world.

Going under the NanoKnife

UC Berkeley engineers developed a way to destroy cell walls without harming nearby tissue vessels, a breakthrough surgical technique that attacks difficult-to-remove tumors. UC Berkeley licensed the technology to AngioDynamics for use in its NanoKnife System. The minimally invasive surgical system, which generated \$7.3 million in revenue last year, received FDA approval for soft tissue removal and is being evaluated for treating prostate, liver and pancreatic cancer.

Diagnosing faster

A UC Davis and Lawrence Livermore National Laboratory collaboration, funded by an NIH grant, tests prototype instruments that could lead to medical professionals diagnosing bloodstream infections within one hour on site, rather than waiting up to several days for conventional test results. Instead of transporting a blood sample to a hospital, doctors may be able to render a diagnosis at an emergency shelter or at a disaster.

Drugs, Delivery & Discovery

Exploring oceans

UC San Diego Scripps Institution of Oceanography researchers explore oceans—a vast, largely untapped resource—for novel sources such as algae and bacteria to help cure human disease. The research includes marine microbial genomics and developing new technologies to genetically engineer pharmaceutically relevant marine natural products.

Safer, cheaper vaccines

A challenge of worldwide health care is the safe, easy and inexpensive delivery of vaccines, particularly to protect children. David Lo's research at UC Riverside on mucosal cell immunology promises needle-free vaccines, as well as immune-boosting vaccines that target respiratory and intestinal tissues, the locus for much of the sickness and death in the developing world.

Gaining insights into genes

UC Berkeley professor Robert Tjian's research has provided new insights into the molecular mechanisms that underlie diseases and conditions from Huntington's disease and cancer to diabetes and infertility. His work focuses on proteins that regulate the expression of genes and their role in cell malfunction and disease. He co-founded Tularik to develop drugs that regulate malfunctioning genes. Amgen acquired Tularik in 2004 for \$1.3 billion.

Disrupting deadly diseases

Insects transmit deadly diseases to hundreds of millions of humans and cause billions of dollars in lost agriculture every year. UC Riverside entomologist Anand Ray has developed a new, inexpensive approach to fight the transmission of infectious disease from blood-feeding insects. The approach uses environmentally friendly odors to disrupt insect behavior and help control the spread of diseases, including West Nile virus, malaria and citrus greening disease.

Inhibiting HIV

In a key step toward reducing the threat of HIV, UC Merced professor Patricia LiWang has designed what may be the most effective chemical inhibitor against infection of the virus. She combined bits of two proteins to create potential ingredients of a new microbicide, which could block HIV from infecting human cells in a sexual setting. Its potency is up to 100 times greater than existing HIV inhibitors.

Lighting the way

Lawrence Berkeley National Laboratory's Advanced Light Source generates intense X-rays, making previously impossible studies possible. Funded by the U.S. Department of Energy, the ALS attracts about 2,000 scientists a year, including researchers from biotech and pharmaceutical firms. Berkeley-based Plexikon used it to help develop a promising melanoma drug, while Gilead Sciences of Foster City used it to help develop HIV therapies.

Countering coughs

Expectorants help relieve respiratory congestion, but many of today's popular over-the-counter medicines can cause side effects. UC Merced researchers found a nanoparticle that breaks down mucus rapidly. The nanoparticles have great commercial potential, as they are inexpensive to produce, easy to deliver via nasal sprays or inhalers and they are not likely to cause side effects. They hold promise for severe respiratory disease such as asthma, bronchitis, cystic fibrosis and COPD.

Reaching Communities

Reducing disparities

UC Davis is home to the National Center for Reducing Asian American Cancer Health Disparities, the only such center for Asian Americans designated by the National Cancer Institute to study populations disproportionately affected by the disease. A \$5.6 million research grant is increasing cancer awareness and building community-focused research. The center also is a consortium of organizations, including UCLA, UCSF, the Chinese Community Health Resource Center in San Francisco, the Hmong Women's Heritage Association in Sacramento, University of Hawaii and University of Washington.

Teaming with the community

UC programs are national models for enabling researchers to work with local communities to create new approaches for improving health. In 2011 the NIH awarded UCLA, in partnership with Cedars-Sinai Medical Center, Charles R. Drew University of Medicine and Science, and the Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center, a five-year Clinical and Translational Science Award of \$81.3 million to focus specifically on health conditions that account for the greatest proportion of disability and early death in Los Angeles County, where rates of heart disease, diabetes, stroke, AIDS, depression, violence and other preventable conditions far exceed national averages.

Preparing the Next Generation

Charting a course for nanomedicine

Nanomedicine promises the ability of the tiniest engineered materials to carry drugs, proteins or imaging agents to diseased tissue while sparing others. UC San Diego's Center for Excellence in Nanomedicine, established in 2010, trains next-generation scientists, physicians and engineers to fuel economic growth through intellectual property generation.

Reaching out

UC Irvine has been a leader in offering programs to increase underrepresented minorities in biological sciences. Participants in the NIH-sponsored Minority Science Programs at UC Irvine benefit from internships, faculty mentoring and access to the latest in technology. The campus also started the UCI Biomedical Informatics Training Undergraduate Summer Research Program, which acquaints community college students with an emerging field that combines biology and computer science. Computational science has become critical to biological research because technologies such as human genome sequencing are so data-intensive.

Hatching ideas, leaders, companies

UC nurtures promising inventors and future industry leaders. It helps graduate students and startups get off the ground at incubators at QB3 at UCSF and UC Berkeley, the California NanoSystems Institute at UCLA and UC San Diego's William J. von Liebig Center, all of which seek to transfer discoveries that benefit society.

Innovation

UC develops more patents than any other university in the nation.

UC researchers produce, on average, more than four new inventions a day. In 2011 alone, UC had 1,581 inventions, including biomedical devices and vaccines.

The top-earning UC inventions over the years include an immune activator for treating cancer (UC Berkeley), a hepatitis B vaccine (UCSF) and therapy for brain aneurysms (UCLA).

