



Today, with more than 50,000 students between them, the University of Utah and Utah State University have come a long way from single-building campuses and their early curricula. Both institutions are vigorously pursuing multifaceted missions of learning, discovery, and engagement. With students, faculty, and a host of stakeholders taking part in that mission, Utah now ranks 11 in the United States for the proportion of higher education degrees to number of residents.¹ Although both universities have contributed greatly in higher education and research, new prospects of fulfillment in economic development have yet to be fully realized.

Utah's Research Universities

The University of Utah today is an academic powerhouse, offering more than 160 degree programs to its 28,000 undergraduate and graduate students. Several of its programs are ranked in the top 50 nationwide, including business, chemical and fuels engineering, and computing.² As the third-largest employer in the state, the University has more than 18,000 people on its monthly payroll and annually distributes more than \$850 million in salaries and benefits.³

Utah State University also is a nationally prominent institution with many highly recognized degree programs, including agriculture, education, engineering, and natural resources. Utah State offers more than 200 majors to its 24,000 students and has significantly increased important research opportunities available to them. The University drives northern Utah's economy, providing more than 5,800 jobs to Utahns in the area. In June, *Consumer's Digest* rated Utah State as the sixth-best-value university in the United States for cost in relation to educational quality, and was ranked second in affordability by the National Center for Public Policy and Higher Education.⁴

Both universities' research programs have been very successful. In July 2004, then Governor Olene Walker, along with Utah State President Kermit Hall and University of Utah President Michael Young, announced the generation of \$500 million in joint

research revenues from the two universities. That represents the largest amount ever garnered by the state. A large majority of this funding comes from the Federal government and private industry, while the state provides less than one-tenth of total research funding for the universities. State funding is often used as seed money to attract the larger Federal grants.⁵

FY04 research funding for the University of Utah and Utah State University achieved double digit percentage gains from the previous year, and doubled amounts compared to a decade ago.⁶ Not only does this substantial growth of research funding support cutting-edge knowledge being developed by university faculty and staff, but much of it is spent within the state, which in turn boosts the overall economy. Every dollar invested in research infrastructure—buildings and equipment—results in a \$10 return in research grants and other economic benefits to Utah.⁷

Increased research funding in Utah has stemmed from strong research programs that both the University of Utah and Utah State University have developed. Although the success of research programs is often measured by the money they bring in, they have also created valuable opportunities for students and needed services for the state. Research discoveries also result in the creation of technologies around which new businesses can be built.

Research at the University of Utah

The University of Utah's research accomplishments place it squarely in the top 15 percent of America's nearly 200 research institutions, creating many benefits for the state in terms of research outcomes, economic development, and human capital development.⁸ For example, more than two-thirds of Utah's doctors and pharmacists have received all or part of their training at the University of Utah, and more than three-quarters of U of U engineering and MBA graduates stay in the state to pursue their careers. Two of the University of Utah's greatest strengths are in the areas of biomedicine and computers.⁹

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Biomedical and Genetics Research: Creating Worldwide Results

The University of Utah's biomedical and genetics research programs are among some of the strongest in the nation. The U's dominance in this field is bolstered by a host of centers, institutes and programs, including a state-of-the-art medical school, world-renowned scientists, and one of the largest cancer study centers in the world. Work by these U of U professionals has generated countless medical, scientific, and practical outcomes. For example, University of Utah genetics researchers did the following—and much more—in 2003:

- Found a new drug that can make the anticancer drug interleukin-2 more effective and less toxic in patients with melanoma or kidney cancer.
- Discovered how the enzyme PKC gamma influences cells in a developing embryo to move to either the right or left side of the body—a discovery that also has implications for how cancer cells spread or metastasize in cancer patients.
- Helped lead an international research team that discovered how children are protected from two of the deadliest forms of malaria when they carry a gene that lets them produce high levels of nitric oxide.
- Led a study showing that people have longer life spans if they also have longer telomeres, which are the ends of chromosomes that grow shorter during aging.
- Helped conduct a multi-center clinical trial that found premature births can be reduced by up to one-third if the expectant mother received weekly injections of a form of the hormone progesterone called hydroxyprogesterone caproate.
- Participated in a study that tested a new generation of cardiac pacemakers and combined pacemaker-defibrillator devices on congestive heart failure patients nationwide. The trial showed significant reductions in the risk of death among patients who used the implanted devices as opposed to medication.
- Showed that by administering the neurotransmitter GABA to aging monkeys, their old brain cells briefly were made to act young again. The study is an early step toward the goal of helping elderly people by reversing age-related declines in vision, hearing, memory and other skills.¹⁰

To maintain its prominence in genetics research, the University of Utah continues to grow its programs. One example is *the Brain Institute at the University of Utah*, a major effort to unite

various fields of study, utilize the university's research strengths and advance understanding in one of science's last frontiers. An ambitious plan calls for raising more than \$100 million for a new interdisciplinary research building and to finance the institute's first five years of research into the brain and brain disorders by an estimated 200-300 faculty and staff.

The University of Utah also focuses on engaging the public through outreach programs aimed at sharing the results and importance of their research. For example, the Genetic Science Learning Center was created to help teachers, students and others understand how their lives and society are influenced by genetics. The center's engaging, interactive website covers everything from the basics of DNA to in-depth explorations of genetic disorders, cloning, stem cell research and gene therapy. *ScientificAmerican.com* has honored the website as one of the five best biology sites on the Internet. During 2002-2003, Learning Center courses and workshops reached over 1,500 educational institutions worldwide.¹¹

Computational Research: Launching New Technologic and Economic Frontiers

The University of Utah has been a leader in computing and imaging research since the beginning of the field of study. The U's distinguished alumni in the computer field include John Warnock, cofounder and board chairman of Adobe Systems; Alan Kay, developer of the personal computer and a participant in the early design of ARPANet, the forerunner of the Internet; Nolan Bushnell, father of the video game industry and founder of Atari; Ed Catmull, cofounder and president of Pixar Animation Studios; Jim Clark, cofounder of Silicon Graphics and Netscape; and Raymond J. Noorda, founder, former president, and CEO of Novell.¹²

The University of Utah's computing research strength is maintained in several research centers, including the Scientific Computing and Imaging Institute, a leader in engineering and research in scientific computing, scientific visualization and imaging. The institute has solved computational and imaging problems in areas such as medicine, geophysics, chemical engineering, molecular dynamics, aerospace fluid mechanics, combustion and atmospheric dispersion.

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Research at Utah State University

Research at Utah State University involves and supports students, attracts external funding, leads to knowledge and technologies, and solves practical problems in the state, the nation, and the world. USU faculty and student researchers are improving education, services and the economy. Accomplishments in research at Utah State are especially pronounced in the areas of space, land and water, and human services.

Space Research: An Opportunity in Education

Utah State University is designated not only as a land-grant university but also as one of the first space-grant universities in the nation. Space research at Utah State includes many programs within the College of Engineering, the College of Science and the College of Agriculture, working in conjunction with the Space Dynamics Laboratory (SDL), which is one of only ten University Affiliated Research Centers in the nation for sensors and supporting technologies.

SDL applies basic research to the technology challenges presented in the military and science arenas, developing revolutionary solutions that are changing the way the world collects and uses data. SDL, the largest research center at USU, generated about \$70 million in research contracts in 2004. Researchers at SDL have enabled significant advances in data compression and quality, developed real-time reconnaissance data visualization equipment, and created thousands of successful sensors and subsystems for over 400 space-borne and aircraft-based payloads.¹³

Some of SDL's current projects include the following:

- A series of satellite-based projects aimed at providing a better understanding of the weather that will allow more accurate weather forecasts and early storm warnings.
- Research by the Center for Atmospheric and Space Sciences that studies atmosphere in relation to Global Positioning Systems. The ionosphere specifically can foul up GPS coordinates by tens of meters.
- LADA, an agricultural growth chamber in which cosmonauts grow vegetables. It is currently operating aboard the International Space Station.

One of the most important contributions the space research program has made is the creation of research opportunities for Utah State's undergraduates. USU has sponsored a number of projects that are almost totally student-developed: For example, Get-Away-

Specials, which are self-contained experiments sent into space on the Shuttle, have been created entirely by students. In large part because of this student research, Utah State University has earned the distinguished honor of having sent more experiments into space than any university in the world.

Land and Water Research: Creating Solutions to Fundamental Problems

Utah State University was founded in 1888 as an agricultural college, but the global environment has dramatically changed since then. While agricultural production, processing, and distribution remains vital, Utah State's research mission has expanded considerably to address earth conservation, biotechnology, food safety detection, and cures for diseases. Research about Utah's natural resources also has evolved to best serve the needs of the state.

Current initiatives in land and water research include the following:

- The Utah State University Water Initiative, an interdisciplinary partnership across the multiple colleges and departments involved with water sciences and engineering at Utah State University, designed to focus the intellectual leadership of the university on integrated water planning that is critical for the Intermountain West.
- Integrated Water and Coastal Resources Management Indefinite Quantity Contract (Water IQC), part of a \$2 billion initiative to provide capacity to respond rapidly to requests for services aimed at helping carry out the integrated water and coastal resources management aspects of USAID development assistance programs.
- "Agrosecurity," and homeland security more broadly, to devise solutions for the United State vulnerability to naturally occurring events and acts of terrorism. Agrosecurity issues are based on gaining a better understanding of potential threats related to plant and animal production, marketing, and processing. Homeland security efforts include the detection and elimination of harmful pathogens.
- Genomics, Proteomics, and Bioinformatics, which involves the study of cellular DNA, protein, and computational methods of these studies. Research in these areas will give scientists a better understanding of how biomolecular processes work, and how they can be used for public health and economic benefits.

Land and water research at Utah State has resulted in practical benefits for the state for over a century, and it has also created innovative technologies.

Education and Human Services Research: A Needed State Service

Utah State University's College of Education and Human Services is another example of excellence in learning, discovery, and engagement, including economic development. One of the largest colleges of education in the nation, Utah State's College of Education and Human Services lists the following among its recent accolades:

- Ranked by *U.S. News and World Report* in the top tier of prestigious graduate schools of education in the U.S. for the past five years—and most recently ranked 38th in a field of over 1100 schools.
- Ranked fourth in the nation among colleges of education in external research dollars generated—\$181 million over the past ten years and \$25 million in 2003-04.
- Top producer of early childhood, elementary, and special education teachers.¹⁴

Utah State University houses many of the nation's most prominent education and human services facilities and programs, including the Emma Eccles Jones Center for Early Childhood Education, the Edith Bowen Laboratory School, the Center for the School of the Future, and the Center for Persons with Disabilities.

The Center for Persons with Disabilities is one of 61 University Centers for Excellence in Developmental Disabilities, Education, Research, and Services located at major universities throughout the United States. These programs provide leadership to support independence of people with disabilities. For over 30 years, the CPD has focused major efforts on the needs of Utah and of rural and underserved populations nationwide. The CPD generates over \$16 million annually. It houses over 70 projects, including the Early Intervention Research Institute, the Reed F. Warren Biomedical Laboratories, the Mountain Plains Regional Resource Center, the Utah Assistive Technology Program, and WebAIM (research on accessible Internet technologies).¹⁵

Another example of research, technology, and outreach is the National Center for Hearing Assessment and Management (NCHAM), which addresses the most common birth defect in babies—hearing loss. NCHAM conducts cutting-edge research to improve screening methods and equipment for testing the hearing of newborns, applies new knowledge about the genetics of hearing loss to screening programs, extends the lessons learned in hospital-based newborn hearing screening to early childhood programs, and determines how screening impacts families. The center works with all hospitals in Utah, and hundreds of other hospitals across the United States and in many other countries.

Both the University of Utah and Utah State University research produces knowledge outcomes for the world, economic benefits for the state, and services for the community. University research results are becoming even more vital as the seedcorn for future businesses and economic growth.

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University Research and Economic Development

On their own, the results of the University of Utah and Utah State University's research are impressive; when combined with the resources needed to create practical outcomes and technology commercialization, university research is potentially revolutionary for the economic vitality of the state. Evidences of the economic benefits created by the University of Utah and Utah State

University are already apparent. They are seen in the growth of patents, licensing, and royalties generated by university technology, and they are manifest in the companies being created from some of those inventions and ideas.

The University of Utah

The University of Utah has utilized the economic strength of research longer than almost any other institution in the nation. In 1968, the U became just the sixth university in the United States to initiate a technology transfer program. Today, University technologies create thousands of jobs and generate hundreds of millions in investment each year. More than 90 percent of the jobs and 77 percent of the investments remain in Utah.¹⁶

Almost 60 new companies have started from University of Utah technology in the past decade alone, the vast majority of which have stayed in Utah. Some of the companies generated with the help of the U's Technology Transfer Office include:

- **Evans & Sutherland:** One of the oldest university spin-offs, it was co-founded in 1968 by David Evans, who also started the U's computer science program. Known for flight simulators and other virtual reality products, the company generated \$84 million in revenue last year.
- **Myriad Genetics:** Founded by former U geneticist Mark Skolnick, the company focuses on identifying disease-causing genes and producing medicines through alliances with pharmaceutical companies. Myriad uses genetic technology licensed from the University.

- **lomed Inc.:** lomed produces non-invasive drug delivery systems, including a product that delivers medication through the skin using a mild electric charge instead of a needle. Founded in 1974, lomed is based on engineering and bioengineering research at the U.
- **Sarcos Inc.:** Sarcos has licensed many technologies from the University and is involved in robotic systems for industry and entertainment, artificial limbs and other medical devices, and various mechanical and electronic microsystems.
- **TerraTek Inc.:** An engineering company founded in 1969, the company provides research testing and equipment for the oil and gas industry.
- **TheraTech:** Founded in 1985, the company is a leader in the development of innovative products based on controlled release drug delivery technologies, such as patches and mild electric pulses.¹⁷

Many of these companies are located at the University of Utah Research Park, which lies adjacent to campus on 320 acres of ancient Lake Bonneville shoreline. The park houses 44 companies, 37 academic departments and approximately 6,300 employees in 35 buildings. Research Park companies have added more than 4,700 jobs to the state's economy, and the annual in-state productivity of park residents exceeds \$600 million. The park provides a special environment for entrepreneurial growth. It is a reservoir of practical research and business opportunities for university faculty and both graduate and undergraduate students.¹⁸

The University of Utah has engaged in other initiatives to bring the results of university research to the consumer market. Technology to Market (T2M) is an alliance of the University and other public and private organizations designed to create a non-profit business accelerator for high-tech companies. The alliance provides start-up businesses with capital, management, advisors, and other consolidated resources. Also, the Lassonde New Venture Development Center teaches Utah students skills needed to assess business opportunities associated with scientific discoveries and innovations emerging from University of Utah labs. Coached by experienced entrepreneurs, Lassonde Center students work with scientists and inventors to understand possible applications for a discovery and define the true market value.¹⁹

Utah State University

New ideas and technologies initiated by Utah State University researchers also have created profitable products and businesses. Nearly 60 companies had their beginnings in

USU research. These companies generate more than \$300 million in taxable revenues, employ 2,000 people, and help create an infrastructure of high-tech businesses throughout the state. Overall, Utah State University research has influenced the creation of more than 10,000 jobs and has brought millions of dollars into the state. Some examples of companies started from USU technology include:

- **HyClone Laboratories:** A worldwide leader in fetal bovine serum production and other media-related product, the company employs over 500 people in Utah and 700 worldwide.
- **Campbell Scientific:** Campbell has produced and sold over 100,000 dataloggers throughout the world and has about 200 employees at its headquarters in Logan, Utah.
- **Wescor:** Wescor develops, manufactures, and markets high quality instrumentation and other products for medicine, science, and industry. The company employs more than 50 scientific, engineering, design, business, marketing, and sales professionals in Logan, Utah.

The use of Utah State research for economic development is reflected at its research park, now known as Innovation Campus. Established in 1986, the campus is home to some 50 companies with about 2,000 employees. The average annual salary of non-students employed at Innovation Campus is \$65,000, which is 25 percent higher than the area's median family income. Efforts by Innovation Campus to create a high-tech hub in rural Utah have been nationally recognized by the U.S. Department of Commerce, which awarded it one of seven "Excellence in Economic Development" awards. This spring, Innovation Campus won the 2004 national award for "Rural Economic Development."

Innovation Campus is increasing its vital role in the region, and in the coming years, it will do it on a much larger scale. With fourteen existing buildings and three more under construction, Innovation Campus is growing rapidly as a center of research and economic activity in Cache Valley; it may well employ as many people as Utah State University (currently the valley's largest employer) in the coming decades. Innovation Campus' recently-completed master plan will guide growth at the campus over the next 40 years to bring it from its current 38 acres to over 150 acres by full build-out.

Research Partnerships and Programs

The University of Utah and Utah State University have taken steps to create research partnerships aimed at sharing resources to attract funding, create better outcomes, and

more efficiently benefit the state. More than 100 faculty members at the U and USU have created partnerships in their research and entrepreneurial efforts.

Partnership in Human DNA Research

Utah's two research universities are working to reduce the burden of conditions of aging one of the nation's largest health and economic concerns. These efforts will position the state as a leader in medicine, public health, and biotechnology, and will build a foundation for sustained economic growth over the coming years.

Recently the University of Utah and the Huntsman Cancer Institute (HCI) applied for a new joint grant from the National Cancer Institute and the National Institute on Aging to create the Utah Program on Aging and Cancer (UPAC). This program combines the usually disparate areas of cancer research and research on the elderly to build new in-roads into geriatric cancer studies.

The UU-HCI UPAC project leaders have invited participation from researchers from the USU Center for Epidemiologic Studies to augment its extensive cancer research. As one of the largest long-term aging studies, the Cache County cohort provides a unique resource for UPAC researchers and will support Utah's continued position as a leader in cancer research.

Partnership in Infectious Disease Studies

Utah State University and the University of Utah are partnering together in cancer and infectious disease studies to win large Federal grants and establish our state as a principal player in cancer, viral and biodefense research. By jointly applying for selected grants, Utah's research universities are able to combine their effectiveness as both a medical and genetics powerhouse and as a leader for therapies of viral diseases.

Partnering together, the University of Utah and Utah State University have applied for Federal funding for new magnetic resonance imaging (MRI) equipment. The University of Utah applied for a grant from the National Cancer Institute that would fund a Core Facility for MRI of small animals, and Utah State enhanced the need by combining its support. The U and USU also are collaborating with Colorado to become a Regional Center of Excellence in biodefense research.

Through these partnerships, the University of Utah and Utah State University will gain an advantage in research competition, allowing them to win even more multi-million dollar Federal grants that will lead to marketable technologies, companies, and jobs.

Other Partnerships

Other recent examples of collaborations between the U and USU include:

- Dr. Ray Reutzel of Utah State University and Jan Dole, Emily Swan, and John Hosp of the University of Utah are working together to develop, deliver, and evaluate Utah's reading First Grant, a \$42 million project.
- USU's Dr. Karl White and John C. Carey M.D. of the U of U School of Medicine are collaborating on a \$22 million NIH project studying hearing loss in infants and young children.
- Mathematics researchers Dr. Lajos Horvath (University of Utah) and Dr. Piotr Kokoszka have been long-time colleagues; together they have published 18 papers and have received two NATO grants and one NSF grant.
- Dr. Sarah Rule (USU) and Dr. Jan Day work together on statewide preparation of early childhood specialists and K-12 teachers in vision and hearing impairments.
- Utah State University has had a relationship with the University of Utah on the student-involved Unity IV rocket project since 1991.

The University of Utah and Utah State University have become world-renowned in their research efforts in biomedicine, genetics, computation, space, land and water, and education and human services. After decades of development, these prolific research programs are now nearing potential payoffs. If Utah policymakers act decisively, Utah's research outcomes may become the state's economic windfall.