

Innovations

Nurturing Biotechnology's Future

In 2004, the Colorado University (CU) Foundation—the university's privately governed nonprofit corporation—committed to a \$10 million limited partnership with Sanderling Ventures, a biomedical venture capital firm.

How does this venture capital investment fit with a university's mission? President Elizabeth Hoffman has identified that “[i]t is increasingly the case that the research problems we tackle do not honor disciplinary boundaries, that no one individual has all the knowledge or expertise to answer the great unanswered questions” [1]. As such, she has set priorities for the university, in all aspects, to deviate from the traditional ways of education, scientific research, and financial investment. She has charged her university to develop innovative methods and collaborations in order to be on the forefront of this century's increasingly interdependent scientific landscape.

Hoffman's vision is meant to foster knowledge, enthusiasm, and leading-edge research at many levels of education by developing multiple intercampus and interdisciplinary initiatives. The vision knocks down walls that traditionally have isolated scientists in differing disciplines. It is designed to inspire pre-college, undergraduate, and graduate students as well as pre-college teachers and faculty to pursue their scientific curiosities and dreams. Focal areas of these efforts include genomics and biotechnology. Expanding relationships among the university's life sciences departments (including the medical school's physicians), scientists, and biotechnology and pharmaceutical industries will also result in practical implementation of scientific innovations. With multiple interlocking programs, CU has cast itself as a place where budding leaders, of all ages, take hold of their science and run with it.

One goal of this initiative is “to bring together scientists from multiple campuses and, probably more importantly, multiple disciplines to

carry out cutting-edge research that will ultimately lead to better quality of life and healthcare,” says Leslie Leinwand, Director of the Colorado Initiative in Molecular Biotechnology. “Students are gravitating toward these interdisciplinary areas and, I think, they will receive unique educational opportunities,” she continues. “The University of Colorado is poised particularly well to do this because we've had traditional strengths in the sciences here on the Boulder campus, and we've got a very collaborative, good-spirited bunch of faculty—who are going to make wonderful discoveries and, frankly, have fun doing this kind of science. It's a true synergy.”

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Butcher Awards

In 2002 the Butcher Awards, one of the most recent university campaigns for pioneering research, issued a call to faculty for proposals in genomics and biotechnology. Thirteen seed grants of up to \$100,000 each, made possible by Charles and Jane Butcher and President Hoffman's office, were awarded. The primary requirement for proposed research was that it had to be interdisciplinary in nature, bringing together faculty scientists who never before had the opportunity to work together. The awards were a springboard for physicists to collaborate with molecular biologists and for chemists to work with mathematicians, for example.

The first awardees presented their findings in November 2004. “It really is amazing how much they fostered innovative, interdisciplinary research that I do not think would have been possible otherwise,” explains Julie Graf, Director of the university's Biological Sciences Initiative.

“The first round of Butcher funding produced a truly extraordinary bunch of results that vastly exceed my best expectations. Everybody walked away from that [symposium] thinking this is the best investment of a million dollars in science that they could think of. It was truly remarkable,” says Leinwand, Chair of the President's Taskforce on Genomics and Biotechnology, the group responsible for making award decisions.

The initiative's hope was that applicants would generate sufficient pilot data to then approach larger grant institutions. The outcomes included findings that are thought to be easily translatable into biotechnology. Several ideas have the potential to be patented, and many awardees have already received larger grants. The results were so impressive to the original funders of the initiative that another \$1 million has been donated for a second round of awards.

Leinwand expects that the findings from these research endeavors will be put into practical use through relationships with clinicians and scientists at the medical school, and possibly through the creation of new biotech companies. In line with the “university without walls” vision, she says, “we are trying to break molds by setting up new relationships that we didn't have before.”

Interdepartmental Programs

Two graduate-level examples of how the university is implementing its interdisciplinary vision include the *Integrated Training for Biotechnology Leadership* program and the *NIH Leadership Training in Pharmaceutical Biotechnology* program.

Both are certificate programs that combine academic work with laboratory research and industry internships. Like other university initiatives, these programs are seen as triple wins, where, in this case, the winners are graduate students, biotech companies, and—as it sees deeper relationships forged with cutting-edge research companies—the university.

The first program links the Molecular, Cellular, and Developmental Biology (MCDB) Department with the Department of Chemical Engineering and the Department of Chemistry & Biochemistry. Its coursework and required industry-based internship, which is typically done in an R&D branch of a local biotechnology company, expose students to the skills required to successfully bring research efforts to commercial fruition. The second program is offered through the Center for Pharmaceutical Biotechnology, an intercampus bridging of the CU-Boulder life sciences departments and the Health Sciences Center (the university's medical school). This program benefits from a \$1.4 million NIH grant for fellowships and typically focuses on industry-based drug formulation, delivery, and characterization.

Biological Sciences Initiative/ Genomics Teaching Place

The university also provides innovative scientific learning and research opportunities for undergraduates and, perhaps more unusually, for K–12 students and their teachers.

Teacher development and support was one of the original primary responsibilities of the Biological Sciences Initiative (BSI) when it began in 1989. “Teachers are really the frontline in terms of the number of youth that they influence and interact with, imparting both information and inspiration,” says Graf. Students often develop their desire to pursue a career in science sometime during K–12. Science teachers, however, “face a really tough challenge trying to keep pace with the many advances in science and keeping the material they are presenting fresh and up-to-date, as well as providing hands-on activities that are meaningfully tied to the curriculum,” says Graf. “That is something that we really try to help with.”

BSI, which has grown from substantial university support and nearly \$8 million in competitive Howard Hughes Medical Institute grants, also has the goal of encouraging students to seek careers in the biological or medical sciences. BSI started with a focus on molecular biology, such as DNA and RNA; genomics has been identified as the next natural step. As such, the university has recently opened its Genomics Teaching Place (GTP).

“The GTP is really a long-held dream come true—a teaching laboratory and classroom to further knowledge in the biosciences. In particular, we were able to design it to facilitate interdisciplinary functions so that we could broaden the access to knowledge about genomics. For example, it is computer-equipped with wireless technology so that students can use the many resources on the Web at the same time that they’re doing the hands-on, wet-lab techniques that are involved in the molecular biology of genomics.”

The GTP opened in 2004, and it serves the undergraduate and pre-college communities at an approximately 50:50 ratio. The pre-college community includes high-school teachers and their students, as well as some at the middle- or elementary-school levels.

“It is awesome watching kids doing a DNA extraction, and it is equally fun seeing adults who have never had the opportunity to do the same,” says Graf. “We recently hosted a group of community leaders at the GTP, including lawyers, business leaders, and numerous others from all kinds of professions other than biology. We led them through a DNA extraction, and they were as excited as fifth graders. We designed the GTP not only to be very functional in terms of the educational aspect but to also be very welcoming to a broader audience. And I think that is so critical, as particularly in this next century our increased knowledge made possible by the power of genomics will touch so many aspects of all our lives, from our food resources and agriculture to medical science and healthcare choices. Just helping people be more acquainted with the concepts and have a better understanding, regardless of their profes-

sion, will help us have a more informed citizenry that is better prepared to make policy decision. So that’s a huge goal, in addition to our goal of getting people in the pipeline who are ready to become the next generation of scientists, and getting people excited about research,” she says.

One way BSI brings in undergraduates is by involving them in research in faculty research laboratories. BSI also offers professional development on the graduate level via the Science Squad. In this initiative, graduate students plan and give hands-on science presentations to approximately 15,000 pre-college students annually in the Denver metro area. The program benefits graduate students and teachers in addition to the pre-college students—yet another example of a triple win.

Expansive Horizons and Deep Bonds

Described are just a few of the numerous programs the university has developed over the last 15 years in the rapidly growing area of genomics and biotechnology. Although the university, by definition, is linked inextricably to the academic side of science, they too have forged very deep bonds with the Colorado biotechnology belt. In fact, many of the university’s researchers have themselves developed start-up biotech companies. Their desire to do this as well as their understanding of how to apply science to new products and services underlies many of the biotechnology programs CU offers. The university’s relationship with Sanderling underscores even further how strongly dedicated the school’s leadership is to promoting scientific exploration and seeing the efforts of its own students and researchers actualized as bioscience innovations. As Michael Byram, President and CEO of the CU Foundation, has said, “It also represents an investment in the university’s intellectual capital and its inseparable link to the future of the Colorado economy. We believe this investment will serve as an important catalyst that may help bring potentially life-saving discoveries from the laboratory to the people who need them” [2].

***Chemistry & Biology* invites your comments on this topic. Please write to the editors at chembiol@cellpress.com**

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References

1. University of Colorado at Boulder (<http://www.colorado.edu>). Accessed December 2004.
2. (15 July 2004). CU announces major investment in biotechnology development. CU Foundation Press Release.