The First 25 Years of the Office of Biotechnology
Iowa State University
1984-2009

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Preface

It has been my privilege to be part of the biotechnology story at Iowa State University since it began 25 years ago. Before leaving the position as the director of the Office of Biotechnology on June 30, 2009, I wanted to record the adventure as a way of thanking the many people who have been an important part of the program. I also wanted to record the history to explain from my vantage point how we got to where we are today and the lessons we learned along the way that may assist others in the future. I was cautioned not to make the book a documentary, so you will have to put up with some of my personal experiences.

I dedicate this book to my wife, Elinor, who has lived this entire journey with me and volunteered hundreds of hours to assist whenever needed. We are grateful to our children Susan, Steven, and Kevin for volunteering their time to the program when they were undergraduate students at Iowa State University.

My sincere thanks to the editor Glenda Webber for sharing her exceptional talents with us for so many years. She has carried out most of the roles in our office at one time or another, including writer, editor, accountant, receptionist, meeting organizer, and more. She earned the nickname "Sherlock" through her uncanny skill of finding information on virtually any subject, which was especially useful preparing for this book.

This book would not have been possible without the work the office staff has done over the years to produce and preserve a record of our activities. As of June 30, 2009, the minutes of 520 meetings of the Biotechnology Council have been recorded, and numerous publications have been produced. My thanks to our current staff of Anne Byrne, Lori Miller, Teresa Peterson, Camie Stockhausen, and Mike Zeller for their assistance in finding key documents that were cited in this book, for reading the entire text, and making helpful suggestions. Their contributions to all the programs of our office are very much appreciated.

It has been a privilege to work with the staff of our instrumentation facilities who have served the university exceptionally well. There is a chapter dedicated to your work, so I will not try to name everyone here. I want to extend my sincerest thanks on behalf of all the faculty, staff, and students who benefit from your dedicated service.

My thanks to the persons who have served the university as vice presidents, associate provosts, or vice provosts for research to whom the Office of Biotechnology is responsible. They all have impressed me with their trust of the faculty members on the Biotechnology Council to recommend how the program should be developed. I have valued the special opportunity to discuss program activities with them one-on-one as they sought to improve the contribution of the biotechnology program to the university and beyond.

It is not possible to thank enough my talented faculty colleagues who have been willing to invest so much of their time as members of the Biotechnology Council. It has been a humbling experience to be surrounded by such gifted individuals who are the leaders in their fields of research. Their guidance has been a key to the success of the biotechnology program. My best wishes to those who will lead the program in the future. I hope it will be as exciting and rewarding for you as it has been for me.

Walter R. Fehr – June 30, 2009

About the Author

Walter R. Fehr is a Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences at Iowa State University. He was the chair of the Biotechnology Council and director of the Office of Biotechnology from its inception in 1984 to June 30, 2009.

Walter grew up on a family farm near East Grand Forks, Minnesota, with his parents, three sisters, and three brothers. His first eight years of education were in a one-room school a mile from the farm. He attended high school at the Northwest School of Agriculture at Crookston, Minnesota, about 25 miles from the family farm. The school was established as part of the University of Minnesota to educate farm youth who were needed at home during the growing season. Students lived in dormitories on the high school campus because their families lived too far away to commute. Classes began in October after harvest and ended the last of March before planting time.

After graduating from high school in 1957, Walter attended the University of Minnesota in Minneapolis. After his first year in liberal arts and sciences, he decided to pursue a career in agriculture, with an emphasis on animal science and agronomy. During his junior year, he took a course in genetics from Dr. Jean Lambert, a barley and soybean breeder in the Department of Agronomy and Plant Genetics. On one of the exam papers, Dr. Lambert wrote a note asking Walter to see him in his office. He was afraid that the professor thought he was cheating and that he was in big trouble. Instead, Dr. Lambert asked Walter if would be interested in joining his research group as an undergraduate intern to learn about plant breeding. He accepted the offer and spent the following summer working with Dr. Lambert and Dr. Rasmusson, a new barley breeder. Walter was given an independent research project to determine the inheritance of a trait that had the potential for controlling a barley disease. That project became the research for his MS degree in plant breeding, which he completed in the summer of 1962.

Walter had married Elinor Otis in 1961, and together they accepted an opportunity in 1962 to teach for two years at the Congo Polytechnic Institute in the country now known as the Democratic Republic of Congo. Elinor taught English and home economics, and Walter taught agronomy. During that experience, Walter decided to pursue a PhD in plant breeding with the goal of teaching at a university.

In the fall of 1964, he began his graduate work at Iowa State University with Dr. Charles Weber, a soybean breeder. After completing his PhD program in May 1967, Walter joined the faculty at ISU as an assistant professor. Since that time, he has taught plant breeding and conducted research in soybean breeding and genetics in the Department of Agronomy. A description of how he became involved in the biotechnology program at ISU can be found in Chapter One of this book.

Chapter One
In the Beginning

My involvement in the biotechnology initiative at Iowa State University (ISU) began in the swimming pool of the Fort Brown Hotel in Brownsville, Texas, during spring break of March 12-16, 1984. My family had a tradition of vacationing together every spring break. This year it was the beach on South Padre Island. Elinor, my wife; Susan (17); Steven (16); and Kevin (13) were pleasantly surprised to find that Donald Beitz and his family from Ames were staying at the same hotel. Don was a faculty member with a joint appointment in the Department of Animal Science and the Department of Biochemistry and Biophysics. While our families were enjoying the pool, Don and I did what faculty often do on such occasions. We talked about things that concerned us at our university. One point of agreement was that our university was not investing enough in the emerging field of biotechnology. It was nice to talk to someone at about the same stage in his career who shared a similar concern for the future.

My interest in biotechnology began during my PhD studies at ISU in 1964. At that time, plant breeding graduate students tended to choose statistical and quantitative genetics as their secondary field of emphasis. There were a smaller number who chose to emphasize biochemistry, physiology, and molecular genetics. My choice was influenced by Donald Rasmusson, one of my advisors for MS studies in plant breeding in the Department of Agronomy and Plant Genetics at the University of Minnesota. He suggested that I emphasize molecular genetics because he believed it was going to become important for plant breeding in the future. I acted on that advice and took as many courses as possible in biochemistry, physiology, and genetics while conducting research on the soybean breeding project with Charles (Doc) Weber, a United States Department of Agriculture-Agricultural Research Service (USDA-ARS) soybean breeder and ISU faculty member in the Department of Agronomy.

One of the positions available at the end of my PhD program was to initiate a research program in soybean molecular genetics at ISU as an assistant professor. In 1967, such a position was not common for plant breeding. The plan was for Doc Weber to continue to concentrate on field research related to cultivar development and for me to emphasize laboratory research in molecular genetics. When I walked into the conference room for my PhD dissertation defense, Doc informed me that he was leaving ISU and the USDA-ARS to begin a soybean breeding program for the Peterson Seed Co. His replacement in the USDA position was to be a breeder who conducted field research related to cultivar development. While that search was under way, I was asked to keep the field program going and to mentor his two graduate students. The initial attempt by the USDA-ARS to fill his position was not successful, which led them eventually to redirect the position from plant breeding to more basic research in soybean cytogenetics. The process took several years, during which time my field research was so extensive that it was not practical to consider establishing a molecular genetics program. Nevertheless, the developments in molecular genetics that related to plant breeding remained a major interest of mine.

Over the ensuing years, I watched the development of molecular genetics in the Department of Agronomy and Plant Genetics at my alma mater. The University of Minnesota was adding faculty positions in that area while maintaining a strong field research program in plant breeding. My concern was that the strong reputation of ISU in plant breeding was going to erode if we did not mount a similar effort at ISU. My discussion in the swimming pool with Don Beitz was timely because I had been wondering if ISU was the right place for me to be in the future.

On the drive back to Ames, I talked to my family about my concern and whether it would be wise to consider moving elsewhere. During the discussion, Kevin asked me a question. "Dad, suppose you had money to buy a home. What would give you more satisfaction? Buying a new home or buying an old home and spending your time remodeling it?" I think that was his way of saying that he did not want us to leave Ames. By the time we got back, I decided to explore the possibility of remodeling the ISU home.

My first visit upon my return was with my department head, John Pesek. He listened to my concern and suggested that I visit John Mahlstede, the associate director of the Agriculture and Home Economics Experiment Station. John listened, but he did not have any suggestions for how to deal with my concern. My next stop was Daniel Zaffarano, the vice president for research and dean of the Graduate College.

I had the privilege of getting to know VP Zaffarano as a young faculty member through a group he formed called the Graduate Research Advisory Committee (GRAC). It was a group of about 10 young faculty members from different disciplines and colleges. It was a stretch to call it an advisory committee because it is doubtful that VP Zaffarano got any useful advice from us. GRAC had a major impact on my career through the interactions with faculty from other disciplines, by getting to know the top administrators whom VP Zaffarano invited to meet with the group, and by spending time with VP Zaffarano and his wife, Susie, at the evening dinners he sponsored to which our spouses were invited. Two of VP Zaffarano's traits that became obvious through the GRAC experience were that he thoroughly enjoyed research and that he had great respect for the ideas of the faculty. Visiting with him about an initiative in biotechnology seemed like an appropriate step to take.

After listening to my proposal for a biotechnology initiative, VP Zaffarano decided without hesitation that it should be done. He and others at the university had been thinking about ways to improve basic research in the biological sciences. One stimulus for the thinking was a letter sent to him dated February 27, 1984, from Martha G. Butt, Vice President of the Northwest Area Foundation in St. Paul, Minnesota. She indicated that the Foundation was inviting ISU to submit a proposal for up to $400,000 to support basic science research.[1] He responded to her in a letter of March 23, 1984, the first paragraph of which read:

> *We are delighted with your suggestion that we prepare a proposal for support of additional staff in basic sciences. As a result of discussions with our president and other administrators, we have decided to use the entire grant of $400,000 over a four-year period to hire young faculty for our Genetics department. By concentrating our investment in one department it is our belief that we can make*

a significant impact on education and research in one of the most essential life sciences at Iowa State.[2]

Given his confidence in the faculty, VP Zaffarano decided to seek advice on development of a biotechnology initiative from leading researchers in the biological sciences from five colleges: Agriculture (now Agriculture and Life Sciences), Engineering, Home Economics (now Human Sciences), Science and Humanities (now Liberal Arts and Sciences), and Veterinary Medicine. The faculty members he chose were Alan Atherly (Agriculture), Donald Beitz (Agriculture), John Hathcock (Home Economics), John Mayfield (Sciences and Humanities), Peter Reilly (Engineering), James Roth (Veterinary Medicine), Carol Warner (Sciences and Humanities), and me (Agriculture). This group eventually became known as the Biotechnology Council (Council).

After VP Zaffarano decided to seek the advice of the faculty on a biotechnology initiative, I was asked by the College of Agriculture to serve as its biotechnology coordinator. A newsletter published by the College of Agriculture in the summer of 1985 read:

The College of Agriculture began a major program during 1984-85 to emphasize the role of biotechnology in future agricultural development. Biotechnology represents the application of molecular biology to the development of useful products. It is an interdisciplinary activity that embraces most of the departments within the college.

Walter Fehr, professor of agronomy, was asked to serve as biotechnology coordinator for the College of Agriculture. Shortly thereafter, he was asked by ISU's central administration to serve as chair of an all-university biotechnology council. In this role, he has responsibility for coordinating the activities of the College of Agriculture with programs of biotechnology in the Colleges of Engineering, Home Economics, Sciences and Humanities, and Veterinary Medicine.[3]

In my role as biotechnology coordinator for the college, I sent the following memo on July 6, 1984, to the departmental executive officers (DEOs, chairs and heads) in the College of Agriculture.

I have been asked by Dr. Mahlstede to prepare a proposal on how we should proceed relative to legislative requests for biotechnology this coming year. I know that you have given this considerable thought, and, therefore, feel it is critical to discuss your ideas and develop a plan with you before submitting anything to Dr. Mahlstede. I would appreciate your presence at a meeting on Monday, July 9 at 2:30 PM in 105 Kildee. Thank you for your cooperation on this important matter. cc: Dr. Mahlstede, Dr. Kolmer [Dean of the College of Agriculture][4]

The planning activity that occurred at the meeting was for both the college and for the Iowa Agriculture and Home Economics Experiment Station (AES) because the dean of the college also was the director of the AES. Although the same person was responsible for both the college and AES, state funds for the two units were requested and administered

independently. State funds for the college were part of the university-wide budget. The state appropriations for the AES were independent of the university-wide budget and administered by the director. Therefore, the request for state funds for agricultural biotechnology proposed through the planning activity was channeled through the AES. The proposal was included in a document dated July 15, 1984, labeled "From Special Needs Requests 1985-86, Agriculture Experiment Station." It called for $2.8 million in 1985-1986 from the State of Iowa for an agricultural biotechnology program. The funds would be used to hire 14 faculty members in molecular biology for departments associated with the AES. The request called for $1.960 million in 1986-1987 and $2.157 million in 1987-1988.[5]

The first activity of the Council in 1984 was to inventory the biotechnology resources of the university. With respect to the number of faculty members with expertise in molecular biology, I recall that we identified about 12 "card carrying molecular biologists," but there is no record of whom we included on the list. It was obvious that the university had to add new faculty with expertise in molecular biology or assist current faculty members in redirecting their research to that area. The only facilities with instrumentation that supported research across the university were the Protein Facility managed by the Department of Biochemistry and Biophysics and the Bessey Microscopy Facility managed by the Department of Botany. Overcoming our weaknesses in biotechnology would require additional funds for the university. This led to a request for funds by President Robert Parks to the Board of Regents, State of Iowa (Regents). It called for $1 million in general university funds for biotechnology and microelectronics.[6] After review by the Regents, their request to the 1985 General Assembly included $600,000 for the general university and $600,000 for the AES.[7]

The funding request led to an article in the *Iowa State Daily* on December 5, 1984, written by M.E. Schneider. Three paragraphs in the article are worthy of note because of the reaction they generated.

> *Zaffarano said expansion plans for ISU biotechnology programs call for emphasis on agricultural developments and genetics research in order to create "plants and animals better suited to Iowa's climate."*
>
> *"The University of Iowa is sort of taking over the 'human emphasis' in biotechnology, in such areas as disease prevention," Zaffarano said. "We want to concentrate more on the agricultural, food production side."*
>
> *Fehr said ISU's Agricultural and Home Economics Experiment Station, located in Curtiss Hall, will "likely take a leadership role in the direction" of ag-related biotech research in the state.*[8]

An important reaction to the article came in a memo to me as chair of the Council on December 7, 1984, from William H. Kelly, Dean of the College of Sciences and Humanities.

> *I have just read the recent article in the ISU Daily and was disappointed to see there was no mention of the activities in biotechnology taking place in several departments in the College of Sciences and Humanities, Engineering and Veterinary*

Medicine. I am sorry to have to inform you that many of our faculty and DEOs in the S&H life sciences are becoming increasingly restless with what appears to be a consistent lack of public recognition of the significant biotechnology programs in Sciences and Humanities in press releases concerning activities of the "Biotechnology Council."[9]

His memo reemphasized that an agricultural biotechnology program had to involve more than the AES and the College of Agriculture. Fortunately, the makeup of the Council was designed expressly to assure that it would be a university-wide effort.

During the fall of 1984, plans were made to highlight the new biotechnology initiative. One important outcome of the effort was the first *Biotechnology Faculty Directory* published in January 1985. Two key paragraphs in the introduction of the directory read:

Biotechnology is an area particularly suited to cross-disciplinary research efforts. Where the development of useful products is desired, interaction between researchers in basic and applied sciences is essential.

. . . .

A primary goal of the council is to create an environment that encourages interaction among people involved in all of the facets of biotechnology. To accomplish this goal, The Biotechnology Faculty Directory was developed by the council and PREPS/Research Services in the Office of the Vice President for Research. This directory will serve as a resource for faculty at Iowa State University who are interested in developing interdisciplinary projects and for individuals in other universities, government, and industry who are interested in establishing collaborative research relationships with Iowa State.[10]

One issue the Council had to resolve in developing the directory was who to include. The two choices were to limit it to persons whose research fit a set of criteria or to let the faculty decide on their own if they wanted to be included. The Council decided on the latter strategy to get as many faculty members involved as possible. Consequently, the directory included 203 faculty members from 34 departments. The directory has been updated and published every year since.

To provide exposure for the biotechnology initiative within and outside of the campus, a biotechnology workshop was planned during the fall to be held January 14-15, 1985, in the Scheman Building (Chapter 2).

To further highlight the importance of biotechnology in Iowa, a request was made in September 1984 to the Iowa Academy of Science headquartered in Cedar Falls, Iowa, to establish a section in the Academy dealing with biotechnology. A new section could be formed if a petition was signed by 25 members of the Academy. In a memo dated September 17, 1984, to the members of the Academy at Iowa State University, I requested the necessary petition signatures.[11] The section was established and biotechnology was highlighted at subsequent Academy meetings.

Despite all of the work done to promote a biotechnology initiative, the Iowa Legislature did not approve any funds for the initiative to either the general university or the AES. Nevertheless, the groundwork had been done that would pay big dividends in 1986.

Chapter Two
The Breakthrough

The year 1985 began with a flurry of activities associated with the first biotechnology workshop at Iowa State University (ISU) on January 14-15. There were multiple groups that we wanted to impress, including the administration, faculty, and students at ISU; industries related to biotechnology; the governor and legislature who were to act on the request for 1985-1986 funds; and teachers and young people in Iowa high schools. A multifaceted program was developed by the Biotechnology Council (Council) with the able assistance of Faye Yates, a communication specialist for the Office of the Vice President for Research; Linda Kennedy, the first secretary for the Office of Biotechnology who joined the program in October 1984 on a half-time basis; and David Pavlik, the leader of the Media Graphics group who made the displays for the workshop.

The workshop, "Demonstrations in Biotechnology," was well attended by all of the target audiences. The attendees included 112 ISU faculty, 27 ISU staff, five staff from other colleges and universities, 55 ISU undergraduates, 104 ISU graduate students, 62 high school students from 13 schools, eight high school teachers, 92 industry representatives, four legislators or their staff members, and 12 participants from the general public.[1] They had the opportunity to see the research displays of 50 ISU researchers and listen to ISU and industry representatives. Research display topics included agricultural diversity in soybeans and corn, nitrogen fixation, plant virus detection, genetic improvement of animals, vaccines and animal health, nutrition and human health, and nine other topics.[2]

Faye Yates in, writing a summary of the workshop, made these observations.

> *Cross a science fair with a scholarly meeting and what do you get? A winning Biotechnology Workshop – if attendance and enthusiasm are any measures of success.*
>
> . . . .
>
> *When the lab show closed down for the night, it signaled the beginning of a more conservative and dignified affair – a banquet, where awards were given to sponsors of 11 newly established full-tuition undergraduate scholarships in the College of Agriculture for students pursuing a program in biotechnology.*
>
> . . . .
>
> *Josef Schuler (ISU '53), Research and Development, CIBA-GEIGY, Basel, Switzerland opened the second day of activities with a discussion of the role of biotechnology in the economic development of Iowa. Urging ISU to "motivate the state's youth to accept the scientific challenge of the next century right now," Schuler went on to say: "If you want to remain an institution of excellence and a top agriculture state, you must execute now the flexibility of your agriculture policy makers to put together a realistic biotechnology program."*

The theme of "biotechnology now" was repeated by Dr. Ernest Hubbard of Sungene Technologies Corp. and Dr. Ashby Green of Monsanto Company during the closing session of the workshop.

By day's end on Jan. 15, one thing was clear. ISU researchers had produced yet another prize hybrid, combining hard science with showmanship. Now, that's entertainment plus.[3]

When ISU put together its request to the Board of Regents, State of Iowa (Regents), for 1986-1987 funds, it included $1.5 million for biotechnology and microelectronics for the general university and $1.5 million for an agricultural molecular and biotechnology program in the Agricultural Experiment Station (AES). The Regents' staff recommended $1 million for the general university and $1 million for the AES. President Robert Parks indicated to the Council that he would ask the Regents to reinstate the original ISU request at its meeting of November 20, 1985, at the Iowa School for the Deaf in Council Bluffs. He invited Council members to attend the meeting in case the Regents had questions regarding use of the funds. James Roth, Carol Warner, Pamela White, and I drove to the meeting together.

The budget hearing was held in a room with a large table for the Regents and university administrators. Those of us who were there as guests or spectators sat in chairs at the end of the room. The budget request for biotechnology funds was not on the formal agenda, but President Parks was going to bring up the topic before the first break in the morning session. The break came and nothing had happened. We gathered around President Parks in the hallway to find out if he would be able to bring up the subject later in the meeting. He was visibly frustrated because he had not been able to bring it up as planned, and there was no chance of doing it later. When we asked him what we should do, he said to do whatever we wanted. To paraphrase his comments, he said we could ignore the Regents and work with whomever we wanted to take a funding proposal directly to the governor and legislature. Maybe he felt he could be so bold because it was his last year as president of the university. Maybe he was just frustrated enough to let us ignore the normal procedure. Whatever the reason, the light was green for action.

The strategy we chose was to get friends in industry to make the request to the governor. We knew that it would have been useless for faculty members to contact the governor directly because it would be viewed as self-serving and the governor would expect that any university request had to be supported by the Regents. We knew the companies and their leaders through the "Demonstrations in Biotechnology" workshop held in January and through our individual contacts with them in our professional work. We referred to this group of industry friends as the Industry Task Force on Agricultural Biotechnology.

We were very pleased with the willingness of industry leaders to become involved in the process on very short notice and equally pleased that Governor Terry Branstad was willing to meet with them to discuss their interest in biotechnology. Only six days after the Regents met in Council Bluffs, the meeting of industry leaders and the governor was held the morning of November 26, 1985, two days before Thanksgiving, in a conference room of the State Capitol Building in Des Moines. Governor Branstad sat at the head of the table and the industry

representatives occupied the remaining places. Douglas Gross, the governor's chief of staff, and I sat in chairs in the back of the room. The industry representatives present included Thomas Urban, Dwight Tomes, and Nicholas (Nick) Frey, Pioneer Hi-Bred International, Inc.; Charles Lewis, Grain Processing Corporation; George Barr, Land O' Lakes, Inc.; Theodore (Ted) Crosbie, Garst Seed Company; and Robert Erwin, Sungene Technologies Corporation.

The timing of the meeting could not have been better. Pioneer had announced earlier that it was investing $2.5 million in research at Cold Springs Harbor in New York, in part because there was no public university in Iowa with the capabilities the company needed in biotechnology. ICI Americas, Inc., a British company and owner of the Garst Seed Company at Slater was evaluating possible sites for their biotechnology research center in the United States. Other companies at the meeting also expressed the importance of biotechnology for their future development in Iowa. As the meeting was coming to a close, Thomas Urban asked, "Governor, would you like to be the champion of biotechnology for Iowa?" Without hesitation, the governor said yes. Charles Lewis remembers the gleam in the governor's eye when he responded positively to the question. The governor proceeded to ask the industry representatives to write something about the need for biotechnology to include in his upcoming Condition of the State Address and to recommend an amount to put in his budget request to the legislature. In addition, I was asked to present a plan on December 5 in writing to Douglas Gross for the governor to consider.

With the help of the Council, a document was prepared titled "Center of Excellence in Agricultural Biotechnology at Iowa State University." With regard to funding, the document read:

> *The university has requested the funds required on a long-term basis to establish a center of excellence in agricultural biotechnology: 1.5 million dollars in the general university fund and 1.5 million dollars in the Agriculture and Home Economics Experiment Station.*[4]

The three industry persons chosen to prepare information for the Condition of the State Address were Ted Crosbie of Garst Seed Company and Nick Frey and Dwight Tomes of Pioneer Hi-Bred International, Inc. The four of us met in early December at the Garst facility at Slater. The three of them agreed that the original request of $1.5 million was far too little to launch the type of biotechnology program they thought was necessary. Instead, they decided to ask for $20 million for a four-year period. Who was I to question such a request?

When Governor Branstad gave his Condition of the State Address on January 14, 1986, a major part of his remarks dealt with the farm crisis in Iowa.

> *I'm here today to report to you on the condition of the State. It must begin with a discussion about the worst agricultural crisis since the Great Depression. Land values in our state have dropped 60 percent since 1981, with over $40 billion of wealth drained from Iowa.*
>
> . . . .

> *Iowa has the potential to be a national center of telecommunications and biotechnology. We can create new businesses by nurturing these growth areas. We can double the amount of new jobs created in the telecommunications field in our state in 1986 and I know of at least two new companies who have already told me of their interest in moving their biotechnology research to Iowa, if we make a commitment in that field. I challenge you today to join me in that commitment to Iowa's future.*[5]

The two companies referenced in his remarks were ICI Americas, Inc., and Sungene Technologies Corporation, a company based in California.

The industry representatives were tireless in their efforts to gain support for the program during the legislative session. They met many times with the leaders of the House and Senate to discuss funding for the initiative. One of the key questions was where the State of Iowa would get the $20 million, particularly during the farm crisis. The response from the industry members was always the same. They did not want to suggest what would be an appropriate source of funds. They would leave that up to the legislature to decide. It was a learning experience for me to sit in the back of the room and listen to the discussions.

After one key meeting, a letter was sent to Representative John Groninga on April 22, 1986, from the Industry Task Force. It read:

> *Thank you for taking the time yesterday to meet with George Barr (Land O' Lakes), Norman Chambers (Iowa Soybean Promotion Board), John Chrystal (Bankers Trust), Ted Crosbie (Garst), Nick Frey (Pioneer), and Jean Linn (Pioneer). We appreciate your interest in the economic development which results from supporting our existing industry and attracting new industry to Iowa – especially that which results from support of biotechnology research at Iowa State University. . . .*
>
> *We were especially pleased to learn at the meeting on Monday that the leadership of the House agreed with the need for 5 million dollars for the first funding year for agricultural biotechnology at Iowa State. . . .*
>
> *We are grateful that you are willing to give agricultural biotechnology a high priority since we are certain that Iowa State intends to use this investment in the most productive manner possible and that we will be able to provide constructive advice and support to ISU by drawing upon our substantial experience in this area. Members of our Task Force will serve on an Industry Advisory Board for Agricultural Biotechnology that was recently appointed by Iowa State University. Members of the Board will include George Barr (Land O' Lakes), John Chrystal (Bankers Trust), Ted Crosbie (Garst), Robert Erwin (Sungene), Nick Frey (Pioneer), Leroy Hanson (Triple "F"), Charles Lewis (Grain Processing), Chris Nelson (Kemin Industries), Tom Tolbert (Monsanto), and Dean Welch (Salsbury Laboratories).* (Appendix 2.1)

On the same date of April 22, 1986, a letter was sent to friends of ISU asking them to call members of a legislative conference committee that was dealing with the differences between the House and Senate bills for funding of agricultural biotechnology at ISU. It read:

> *The bill regarding funding of agricultural biotechnology at Iowa State University through the use of lottery money, identified as House File No. 2412, has gone to a conference committee to resolve the differences between the Senate and House versions. The original House bill called for 3.5 million a year for each of four years. The Senate amended it to provide the equivalent of 5 million each year for four years, which agreed with the recommendation of an Industry Task Force on Agricultural Biotechnology.*
>
> . . . .
>
> *The calls should only be made by business persons or by farmers who are members of commodity organizations. Calls made to the conference committee members by ISU faculty or administrators will do more harm than good. The committee members do not care about the opinion of ISU.*[6]

One key factor in the success of the industry leaders was a meeting orchestrated by Ted Crosbie between leaders of ICI Americas and the legislative leaders. It was a meeting well attended by members of the legislature and the press. The representative from ICI Americas indicated that if the State of Iowa provided the funds requested for ISU, they would locate their US biotechnology research facility in Slater. In my opinion, that sealed the deal. The question that remained was where to find the money. The answer was the lottery funds that the state had begun to collect but had not yet decided how to spend.

Funding for the biotechnology initiative was included in the *Acts and Joint Resolutions Passed at the 1986 Regular Session of the Seventy-first General Assembly of the State of Iowa* in Chapter 1207, Allocation of Lottery Funds, H.F. 2412, Sec. 7.d.

> *To the Iowa Development commission the sum of ten million (10,000,000) dollars to be allocated by the Iowa development commission for economic development and research and development purposes at an institution of higher education under the control of the state board of regents or at an independent college or university of the state. The Iowa development commission shall allocate for the fiscal year beginning July 1, 1985 the first five hundred thousand (500,000) dollars, for the fiscal year beginning July 1, 1986, the first three million seven hundred fifty thousand (3,750,000) dollars, and for the fiscal year beginning July 1, 1987 and for each succeeding fiscal year the first four million two hundred fifty thousand (4,250,000) dollars to the Iowa state university of science and technology for agricultural biotechnology research and development. From the money allocated to the Iowa state university of science and technology for agricultural biotechnology research and development the amount of fifty thousand (50,000) dollars for each of the fiscal years beginning July 1, 1986 and July 1, 1987 shall be used to develop a program in bioethics for research at the university. This program should address socioeconomic and environmental implications of biotechnology research.*[7] [*sic*]

In addition to the lottery funds, ISU was authorized to issue $1 million in bonds for the development of infrastructure to support the biotechnology program.

The breakthrough had occurred. Now it was time to decide how to spend the funds.

Chapter Three
Guiding the Way

During the legislative session in the spring of 1986, Gordon Eaton was chosen to replace Robert Parks as the new president of Iowa State University (ISU). Even before he began his employment at ISU in 1986, he was well aware of the work under way by the industry leaders to secure biotechnology funds for the university. He had met with the group in a conference room at the Des Moines airport during one of his spring visits to ISU. After the biotechnology funds were appropriated in the spring, President Eaton invited the industry leaders to his conference room in Beardshear Hall to thank them for their work and to seek their advice on how to use the new resources. Charles Lewis from Grain Processing Corporation made a statement that became the guiding principle for the program. "President Eaton, do not spend the money like butter on warm toast." He and the other industry leaders wanted the money spent in a way that would make it possible in the future to readily determine if the investment had been used effectively to build a strong biotechnology program at ISU.

One strategy considered was to divide the funds among the five colleges and let them decide how best to use them. This strategy was favored by the college deans and departmental executive officers. It was not the strategy that President Eaton chose to implement. Instead, he decided to follow a plan developed by the Biotechnology Council (Council) that was sent to administrators on April 14, 1986. Because the plan served as the framework for management of the new funds, it is included in its entirety as Appendix 3.1. A paragraph that described the overall administrative strategy read:

> *The administrative plan described in this document is based on the principle established by President Parks, in consultation with other administrators of the university and with the Industry Task Force on Agricultural Biotechnology, that the biotechnology program will be administered on a university-wide basis through the Office of the Vice President for Research. It is intended that the university-wide program will respect the current administrative structure of colleges and departments, while establishing an aggressive intercollegiate and interdepartmental program that involves the Colleges of Agriculture, Engineering, Home Economics, Sciences and Humanities, and Veterinary Medicine.*

The typical administrative strategy would have been for Vice President for Research Daniel Zaffarano to receive requests for funds and decide on his own what activities to support. That was not the strategy he chose. He reasoned that because it was the Council working with the industry leaders that resulted in the new funds, it should be the Council that provided leadership in building the biotechnology program. He would have the final say on what was spent, but he would not disburse any of the funds without the recommendation of the Council. The strategy he chose to follow has been emulated by every one of the individuals who have succeeded him in that position through 2009.

The plan of action of April 14, 1986, called for the formation of a Biotechnology Institute (Appendix 3.1). That part of the plan was not implemented. Part of the reason was that, in 1986, there was reluctance to add institutes and centers at the university, a much different environment than exists today. Nobody was interested in doing the large amount of work that was necessary to get an institute or center approved by the Board of Regents, State of Iowa (Regents). VP Zaffarano and the Council were satisfied with a less formal administrative unit that became known as the Office of Biotechnology (Biotech).

The formation of an institute was discussed again in 1988 with Associate Provost for Research (AP) Norman Jacobson. A memo I wrote to him on December 21, 1988, read:

> *Thank you for the opportunity to share with you some comments relative to the development of a formal Biotechnology Institute at Iowa State University. When I discussed this topic with you on November 9, I wondered if the informal arrangement that we have had for the administration of the biotechnology program at ISU might hinder our effectiveness in the future, particularly with respect to obtaining outside funding. I would like to share with you what I consider to be some of the pros and cons of developing a formal institute.*[1]

One advantage for a formal institute outlined in the memo was that the director would have formal authorization for various administrative matters, including signature authority. A second advantage was that the institute could participate as an academic program. Another advantage was that the institute could submit proposals for funding. The Office of Biotechnology was acting as if it had all of the advantages of a formal administrative unit, but without formal authorization by the Regents.

Two disadvantages for establishing an institute were cited in the memo.

> *On the negative side, I would not want the program of the Office of Biotechnology to become competitive with the departments and colleges of the university. I do not know if people would see the formation of an institute as being a threat, but it is something to consider. . . .*
>
> *A second negative aspect is the objection that we may encounter from the University of Iowa and University of Northern Iowa. I know that the University of Iowa attempted to establish an Iowa Biotechnology Institute. Iowa State University objected to the title of that institute because it suggested that they were representing the total state program.*[1]

When Patricia Swan became the vice provost for research, we discussed again whether the Office of Biotechnology should become an institute or center. We agreed that changing the name to Biotechnology Institute or Center could do more harm than good in our cooperation with other administrative units on campus. The title Office of Biotechnology has served the program well over the years.

One of the key factors in the success of the Biotech program has been the Council established by VP Zaffarano in 1984. He believed that the faculty were a valuable resource for determining how best to improve the research capabilities of the university. As Dean of the Graduate College, he considered excellence in research as essential for the education of students.

On April 9, 1986, VP Zaffarano wrote a memo to the Council describing his plans for the makeup of the Council beginning July 1 that read:[2]

> *The Council will consist of ten people, including the Coordinator. Each member must have an active program in biological (or related) research. Groups of three members will initially serve for one year, two years, or three years. The Coordinator will be appointed for four years.*
>
> *The membership will be approximately in proportion to the representation of each college in the 1986 Biotechnology Faculty Directory, which is*

College	*Biotechnology Faculty*	*Voting Members*
Agriculture	*137*	*4 (includes Coord.)*
Engineering	*18*	*1*
Home Economics	*10*	*1*
Sciences and Humanities	*36*	*2*
Veterinary Medicine	*60*	*2*

The minutes of January 9, 1987, recorded the establishment of the rotation.

> *Council membership rotation:*
>
> *Council members who have served since 1984 were given the opportunity to voluntarily complete the three-year term on June 30, 1987. Alan Atherly requested to do so.*
>
> *Colleges with two representatives who have served since 1984 will retain one of the representatives until June 30, 1988. Donald Beitz will continue as the representative for the College of Agriculture. By virtue of a coin toss, John Mayfield will end his term on June 30, 1987, and Carol Warner will complete her term June 30, 1988, representing the College of Sciences and Humanities. By virtue of a coin toss, James Roth, representing the College of Veterinary Medicine, will complete his term on June 30, 1987, and Peter Reilly, representing the College of Engineering, will continue until June 30, 1988.*[3]

Because the rotation of Council members recorded in the minutes of January 9, 1987, would have resulted in three members being changed in 1987, four in 1988, and two in 1989, the Council revisited the rotation plan at their next meeting two weeks later. They voted to extend until 1989 the three-year term of Pamela White that would have ended in 1988.

The Council members during the past 25 years with the colleges they represented are listed in Appendix 3.2. Their service to the university in this role has been invaluable.

New Council members have been appointed by the vice presidents for research based on recommendations from the deans of the colleges. The general guidelines have been that the individual should be tenured and have demonstrated excellence in biological research, preferably in some aspect of molecular biology. Additional considerations have been that the new member should maintain the balance of expertise in animal, plant, and microbial research on the Council and should not be from the same department as another member. Department chairs and college administrators generally have not served as Council members.

One factor that has made the Council so effective is that the members have provided input as members of the university community and not as representatives of their college. The improvement of the university as a whole has been their mission.

Another important characteristic of the Council has been their collective expertise on biotechnology research. The range of topics included in biotechnology is so broad that no person can have an in-depth understanding of every issue the Council has had to address. However, there always has been at least one member with the expertise to help the others understand the issue under consideration.

A third critical factor in the success of the Council has been the willingness of the members to devote the necessary time to provide input on a regular basis. During the academic year, there has been a time reserved to meet every week for an hour. Rarely has there been a meeting when a quorum was not present. Even at those meetings, recommendations have been made so matters could be dealt with in a timely manner.

The dedication of the Council members is directly related to the importance placed on their recommendations by every vice president for research who has been responsible for the program. During the 25 years of the program, none of the vice presidents for research have spent any of the Biotech funds without the recommendation of the Council. Any requests for funds made directly to the vice presidents for research have been sent to the Council for their review and recommendation. The following is a list of the individuals who held the office during the past 25 years. The title has varied from vice president to associate provost to vice provost through the years. Some individuals were interim in the position. The term of VP Swan was interrupted when she served as interim provost for about one year.

Daniel J. Zaffarano	March 15, 1971, to June 30, 1988
Norman L. Jacobson, Associate	July 1, 1988, to September 30, 1989
Patricia B. Swan	October 1, 1989, to July 31, 1991
John M. Dobson, Interim	August 1, 1991, to June 30, 1992
Patricia B. Swan	July 1, 1992, to December 31, 1999
William Lord, Interim	January 1, 2000, to August 31, 2000
James R. Bloedel	September 1, 2000, to August 31, 2005
John R. Brighton	September 1, 2005, to June 30, 2008

Theodore H. Okiishi, Interim	July 1, 2008, to March 31, 2009
Sharron S. Quisenberry	April 1, 2009, to present

The close relationship between the Council and the vice president for research led to the perception that the Council was controlling the Biotech funds. The Council has always known that its role is to provide recommendations to the vice president for research. Implementation of each recommendation has required the concurrence of the vice president for research. Nevertheless, the perceived power of the Council led to interesting situations. One of those came in the form of a letter dated September 3, 1987, from Claire Hueholt, editor-in-chief of the *Iowa State Daily*, the university's student newspaper.

September 3, 1987

Professor Walter R. Fehr
1212 Agronomy
Chair, Biotechnology Council

Under Chapter 21 of the Iowa Code, we are requesting that you provide us with photocopies of the following documents:

1) *Minutes of all meetings of the Biotechnology Council since the committee was established.*

2) *All applications and/or requests for funding from the Biotechnology Council.*

3) *All transcripts, receipts, vouchers or related documents which indicate that money was transferred from the Biotechnology Council to a team of researchers.*

4) *All other transcripts, receipts, vouchers or related documents which indicate that money was allocated from the Biotechnology Council to an outside source.*

5) *Minutes of the External Review Committee and/or other documents related to the work of the External Review Committee.*

6) *Correspondence related to the work of the Biotechnology Council between Council members and:*

    a) *Other members of the Biotechnology Council (this includes past council members)*

    b) *Other University employees (including but not limited to: Gordon Eaton, Daniel Zaffarano, Reid Crawford, Warren Madden, and Glenda Gotter)*

c) ISU students

d) Employees of the State of Iowa (including but not limited to Governor Branstad and members of the Iowa Legislature)

e) Members of the External Review Committee

f) Researchers from other research institutions

g) Applicants for grants from the Biotechnology Council

Thank you for your cooperation.
(signature)
Claire Hueholt
Editor-In-Chief

CC: Gordon Eaton, Warren Madden, Daniel Zaffarano, Ralph Rosenberg, Reid Crawford, and Julianne Marley[4]

We agreed to provide the photocopies she requested if the *Iowa State Daily* paid for the copies and the labor. On November 20, 1987, a bill for the work was sent to Claire Hueholt in the amount of $931.39.[5] I do not recall that a single article was written from those records.

The *Daily* also decided it wanted to have a reporter at the Council meetings. After consultation with university legal staff, the Council voted to formally indicate that all of the meetings were open to the public, except for discussions related to personnel. A *Daily* reporter attended a few meetings, but did not write about any of them. We assumed he stopped coming because they were too boring.

During the tenure of VP Swan, one dean complained to her that the Council lacked adequate oversight. Although she did not consider the criticism to be valid, she asked that in all subsequent communications we not say that the Council "decided" anything. Instead, she wanted us to be careful to always say "recommended." You will note that her admonition has been strictly adhered to in this writing.

The power attributed to the Council is still evident today. It is not uncommon to read documents that indicate that the Council contributed funds to some program or project. Although not technically correct, it is that respect of the Council's work that has motivated faculty to give of their valuable time to serve as members.

Although most of the recommendations of the Council have been approved by the VPR, there were a number of cases when the VPR and I had discussions before action was taken on an issue. Even if the VPR did not strongly support an action recommended by the Council, they generally agreed to give it a chance. In the early years of the program, VP Zaffarano and I met frequently with AP Norman Jacobson. I considered it my responsibility to convince the VPR that the recommendation of the Council was worthy of his support. That sometimes

led to a debate about the merits of the recommendation. AP Jacobson said that his role at the meetings was to serve as the referee. I have always enjoyed those discussions with VP Zaffarano because they never became personal. I enjoyed the same relationship with other VPRs as well.

When Patricia Swan was the VPR, she would frequently question the recommendations of the Council. Even though she was not always enthusiastic about our plans, she generally was willing to let us "experiment" with them. It was up to Biotech to be sure they worked.

A March 1986 position paper written by the Industry Task Force called for a full-time director to insure the success of the biotechnology initiative. VP Zaffarano was not in favor of a full-time director because he wanted me to remain active in teaching and research. As a full-time administrator, he missed the opportunity to be involved in those activities and did not want me to give them up at that time in my career. I am grateful he gave me that advice because it is hard to imagine now what it would be like to have missed the challenges and opportunities provided by my research and teaching activities since 1986.

VP Zaffarano's view was supported in the April 14, 1986, document I wrote on behalf of the Council regarding the establishment and operation of a biotechnology institute at ISU. It read:

> *It is not clear if the responsibilities associated with the position will require that the director be on a full-time appointment to the institute. Until this is clearly established, it is recommended that the director initially be on a 75% appointment to the institute and a 25% appointment to a college and department.* (Appendix 3.1)

Although the recommendation in the memo was for 75% of my salary to be paid by Biotech and 25% by the College of Agriculture and the Department of Agronomy, VP Zaffarano decided that 90% would be covered by Biotech and 10% by the other two units. Regardless of my salary allocation, he indicated that it was up to me to decide how to spend my time to carry out the activities in administration, research, and teaching. That same freedom was given to me by every person who has been a VPR, for which I am grateful.

The title of biotechnology coordinator was used for my position until Patricia Swan became the vice provost for research. She decided that it was more appropriate to designate the position as biotechnology director and quietly made the change without any formal review and any objection.

As the time I spent on the biotechnology program rapidly expanded in 1986, I became concerned that it was not possible to devote sufficient time to soybean breeding research. In a memo of November 25, 1986, to VP Zaffarano, I wrote:

> *During the past two years, I have not spent enough time supervising research activities, keeping in touch with the agencies that support my research, seeking additional grants, and writing journal articles. In brief, the farmers of Iowa and*

the university deserve better than I have been able to give them. Therefore, either I should resume my position as a full-time research leader or someone should be hired to take my place.[6]

The decision was to hire an additional soybean breeder who would take over some of the research responsibilities. After the person was hired, I continued my research on a smaller scale. That only lasted a few years because the new hire left ISU. By that time, the biotechnology program was well under way and did not require as much time as it had initially. The new soybean breeder was not replaced. Thanks to the generosity of all the VPRs, I have been allowed to allocate my time as necessary to carry out both my faculty and administrative responsibilities

The successful management of programs in Biotech is the result of dedicated individuals who have served the program so well over the years. In 1984, the only staff member was Linda Kennedy who served as a half-time secretary. Today, there are 21 individuals who receive all or part of their support from Biotech. I am grateful for the dedicated service of every past and current staff member (Appendices 3.3 and 3.4).

The only time the administrative structure has been seriously questioned was when state funds were markedly reduced beginning July 1, 2003 (Chapter Five). When VP Bloedel and I objected to the reduction, Provost Benjamin Allen appointed a task force to review the program (Chapter Five). The part of the August 19, 2005, report of the task force appointed by Provost Allen that dealt with changes recommended in the administrative structure read:

The key activities of the OB should continue to be available campus wide. A biotechnology research faculty council which includes the director of facilities mentioned below remains valuable because it brings together representatives of the now large community of researchers involved in biotechnology research. This faculty council, chaired by a faculty member elected by the council, should be maintained to advise the VPR on facilities, to select students for fellowships, and to serve as forum for faculty discussions in the general area of biotechnology research. An annual report of activities should be submitted by this council to the VPR and the director of the ES [Agriculture Experiment Station].

We believe that the vital and highest priority activities mentioned above could be effectively administered in the future with a leaner infrastructure than is currently in place. Specifically we recommend:

- *Hire a part-time 50% faculty to serve as director in charge of the biotechnology facilities, and to administer the fellowship program. This person would be an ex officio member of the faculty council mentioned above and would report to the VPR.*

- *Hire a full time assistant to the director to support his/her supervision of the facilities, to administer the fellowship stipends, to support the biotechnology council, and perform related communications work.*[7]

On February 16, 2006, I wrote to VP Brighton with my concerns about the recommended changes in the administrative structure. The memo read:

> *The purpose of this memo is to summarize our discussion on those items for which the implementation plan will differ from that proposed by Provost Allen.*
> . . . .
> *We did not discuss the proposal to have a separate Chair of the Biotechnology Council and the director of Biotechnology Facilities. I think much more thought should be given to this separation before it is implemented. The proposal suggests that the administration is unaware of how much time the director invests in the total program, not just the biotechnology facilities. I would not be interested in being the director if the only duty was to oversee the biotechnology facilities because that work is routine. That responsibility alone would not require more than 10% of the time of a faculty member. The most rewarding part of the job is being actively involved in all of the other activities supported by the Office of Biotechnology to find new ways to make them even better than they are today.*[8]

In response to my memo, VP Brighton wrote to me on March 21, 2006.

> *Separation of the roles provides the university the option, after you step down from these roles at the end of 2009, to establish a rotating Chair of the Biotechnology Council. I believe that, to be most effective in responding to the diverse and changing needs of ISU, the Chair of the Biotechnology Council should have a term appointment that rotates among faculty with research strengths in the biotechnology area. On the other hand, I believe the best way to assure the high quality of our Biotechnology Facilities is through continuity in leadership by a director with strong facility management skills. . . . I believe that separation of the roles is appropriate. Note, however, that we appreciate your willingness to continue in both of these roles until you step down from both at the end of 2009.*[9]

There was no further discussion of the administrative structure until I met with VP Brighton and Associate VP Charlotte Bronson on April 14, 2008. I had told them in an earlier e-mail that I considered it best to have the new director identified by January 1, 2009, so that the individual could be involved in the financial planning that takes place in the spring. I would end my responsibilities as director on June 30, 2009. Charlotte mentioned the recommendation of the task force concerning the change in administrative structure, but VP Brighton indicated that contrary to his March 21, 2006, memo, he did not believe the administrative structure should be changed.

A similar discussion took place with Interim VP Ted Okiishi and Associate VP Bronson during the summer of 2008 when it was time to begin the search for the new director. The task report of 2005 was chaired by VP Okiishi when he was the associate dean for research in the College of Engineering, so he was familiar with the change in the administrative structure recommended at that time. I was grateful that he was willing to listen to my reasons for not implementing the recommendations of the task force with regard to the administrative structure and duties of the director. We also discussed at that time whether there should be

an external or internal search for the new director. VP Okiishi indicated that some persons had suggested going outside ISU to hire a well-known scientist in molecular biology. Given the talent within the ranks of our ISU faculty, it was decided to first conduct an internal search. The job description sent to the faculty by e-mail on September 8, 2009, read:

> *The Director will build on the success of the Office of Biotechnology in its mission of advancing biotechnology at ISU and assume a leadership role in helping ISU adapt to the changing nature of biotechnology as the discipline evolves and expands. Activities of the office include facilitating the hire of outstanding faculty researchers, providing outstanding service facilities that meet the needs of ISU researchers, promoting the understanding of biotechnology by the public, and other activities to assure ISU maintains a leading role in biotechnology research, outreach and technology transfer.*
>
> *The Director will manage a budget consisting of state funds and endowment income totaling approximately $2.1 million per year. The Director will hire and supervise staff in the Office of Biotechnology and oversee staff in each of the Biotechnology Instrumentation Facilities.*
>
> *This position reports to the Vice President for Research and Economic Development.*[10]

The plan was to have the new person appointed to the position by January 1, 2009, so there could be a six-month transition period. The search took a little longer than expected. James Reecy, a faculty member in the Department of Animal Science, was selected for the position and joined the Office of Biotechnology on April 1, 2009, as the associate director. He began his appointment only one day before the budget review process began.

When I was discussing the transition with my son Kevin, he asked how I was going to handle "office ego." As a doctor in a community health clinic in Madison, Wisconsin, he had noted that it was not uncommon for people to judge their status in an organization by the size of their office. He wondered if I would keep my office that was larger than others in our unit until June 30 or give it to Jim on April 1 and move into a smaller one. Not wanting to look poorly in the eyes of my children, Elinor and I moved my things to a smaller office on the weekend of March 28 so the larger one was ready for Jim on April 1.

The transition has gone very well. As I leave the position on June 30, 2009, the staff of the Office of Biotechnology is ready to handle whatever the future may hold.

Chapter Four
A Financial Foundation

The Office of Biotechnology (Biotech) has been in the enviable position of obtaining some of its annual financial support from endowments that were established beginning with funds appropriated by the state in 1986. Unlike other appropriations from the state that had to be spent by the end of each fiscal year, the interest from the endowments can be carried over from one fiscal year to the next. As a result, it has been possible to plan and conduct program activities without worrying if unused funds would have to be spent in a rush. The carryover interest was invaluable when Biotech had to deal with a major reduction in state funding on July 1, 2003 (Chapter Five). Without it, Biotech would not have been able to meet its obligations to faculty with startup funds or maintain other valuable program activities.

The first endowment resulted from a meeting that Vice President for Research Daniel Zaffarano and I had in 1985 with Donald Duvick, the vice president for research at Pioneer Hi-Bred International, Inc. Donald had called me to ask how his company could support the new biotechnology initiative. I invited him to meet with VP Zaffarano to discuss some possibilities. At the meeting of the three of us in VP Zaffarano's office at Iowa State University (ISU), Donald suggested the establishment of a chair in molecular biology as a way to bring visibility to the new initiative. He agreed to request $500,000 from his company, with the understanding that it would be matched by other funds raised by ISU.

A press conference to announce the Pioneer Hi-Bred Chair in Molecular Biology of Maize was held September 28, 1985, in the Darling Lounge of the Scheman Building at ISU on the morning of the football game between the ISU Cyclones and the University of Iowa Hawkeyes. The speakers were Owen Newlin and Daniel Duvick from Pioneer and ISU President Robert Parks. Iowa Governor Terry Branstad, US Senator Charles Grassley, Iowa legislators, and ISU faculty and staff were in attendance. The *Des Moines Register* article about the event read:

> *"If you're wondering whether we're going to accept this, we are," said Parks. "You can be sure we will match this grant. We don't know exactly how, but we'll get it done. We'll punch every button and pull every lever until we get the matching money."*
> . . . .
> *Grassley made a $500 contribution to the effort to match Pioneer's grant.*
>
> *"That's private funds," Grassley said, adding, "If you want to come to the federal treasury, I'll see what I can do for you."*[1]

The matching funds came from the state appropriation for the biotechnology initiative in 1986. The appropriation included $500,000 for FY1985 that ended on June 30, 1985. The Biotechnology Council (Council) recommended that the funds be used for the match and VP Zaffarano concurred. The original intention was to hire a well-established molecular biologist

with a strong record in maize research. There were several failed attempts to find such an individual because institutions did not want to lose their best researchers. It finally was decided to hire a more junior person with promising credentials. Thomas Peterson was hired in 1993 to fill the Pioneer Hi-Bred Chair position that he has held ever since.

As plans developed in 1986 for spending the new state funds, it became apparent that it would be difficult to wisely spend $18 million in only four years. I spoke to VP Zaffarano and Warren Madden, the vice president for business and finance at ISU, about the possibility of establishing an endowment with some of the money. I was told that the university had never done such a thing with state funds, but they were willing to request permission to do so. Their request was approved by the state. In fact, some persons in state government thought we should put more into endowments than was planned. A general biotechnology endowment was established with $1 million from the fiscal year beginning July 1, 1987 (FY1988), and $2 million dollars for the fiscal years beginning July 1, 1988, and 1989 (FY1989 and FY1990).

In December 1987, the Council was asked to consider providing funds to the Carlyle G. Caldwell endowed chair in the Department of Chemistry. Work on raising $1 million for establishing the chair had begun in 1981. The department had tried in 1985 and 1986 to obtain $500,000 in lottery funds from the state for the chair, but it was not successful. The Council recommended to VP Zaffarano that the request from the Department of Chemistry for $300,000 of matching funds from Biotech be approved and he concurred. The Caldwell endowment has supported four individuals: Alan Schwabacher, William Jenks, Daniel Armstrong, and Nicola Pohl.

The Council had identified two major pieces of equipment that would be valuable as part of its plan to establish state-of-the-art service facilities at ISU: a scanning transmission electron microscope (STEM) for the existing Bessey Microscopy Facility and a nuclear magnetic resonance spectrometer (NMR) with which to establish a new service facility. During the summer of 1988, the central administration of ISU gave Biotech permission to approach The Kresge Foundation in Troy, Michigan, for funds to purchase the instruments. On September 13 of that year, Dayton D. Hultgren, the executive director of development for the ISU Foundation, and I traveled to the office of The Kresge Foundation to discuss the request with Harold Gene Moss, a program officer for Kresge. He told us that a proposal could be submitted for a Kresge Foundation Science Initiative Grant. The guidelines of the grant program stipulated that The Kresge Foundation could be asked to provide $500,000 toward the equipment purchase. However, ISU would be required to provide $500,000 in matching funds. In addition, the grant from Kresge would be made on a challenge basis to assist the university in raising a permanent $2 million endowment for the future maintenance and updating of research equipment at ISU. Therefore, the request for $500,000 would be part of a total package of $3 million, the majority of which had to be raised by ISU.[2]

On September 20, 1988, the Council recommended that Biotech provide the $500,000 in matching funds and VP Zaffarano concurred. In a memo dated April 20, 1989, from Alfred H. Taylor, Jr., Chairman of The Kresge Foundation, to ISU President Gordon P. Eaton, the

university was informed that a science initiative grant of $500,000 was approved for the purchase of the NMR spectrometer and STEM.

The $2 million endowment required by the Kresge grant was primarily established by funds obtained by ISU through the sale of WOI-TV. Sale of the commercial television station owned and operated by ISU was highly controversial. Given the importance of that sale to the biotechnology program, a description of the sale written by Glenda Webber follows:

> *WOI-TV was the first television station in the United States that was owned and operated by an institution of higher learning. The station began broadcasting to central Iowa in 1950 and was granted a license from the Federal Communications Commission. Broadcast journalism students at the university gained experience at the station while working alongside paid employees. The station was owned directly by the university until 1987 when the Board of Regents, State of Iowa, approved the restructuring of WOI-TV as an independent television station under the Iowa State Broadcasting Corporation (ISBC). The ISBC operated independently of the university, but provided services to the university primarily in the form of technical support, access to studios, and use of facilities. In addition, the station made a cash payment of $400,000 to the university for fiscal year 1988. The Board of Regents, State of Iowa, mandated that the cash funds be utilized for agriculture biotechnology programs. To help complete the $2 million endowment required for The Kresge Foundation Science Initiative grant, President Gordon Eaton committed the funds received from the ISBC related to the operation of WOI-TV to a WOI Trust biotechnology endowment.*
>
> *The Board of Regents, State of Iowa, decided in September 1991 to sell the station. This met with opposition from a group of Iowa citizens who challenged the Board's legal right to sell the station. The opposition group was incorporated as Iowans for WOI, Inc., and filed a lawsuit against the Board in June of 1992. The opposition group won in district court but lost when the decision was appealed to the Iowa Supreme Court. In November 1993, the district court was overruled and in March 1994 the university sold WOI-TV to Capital Cities Communications, Inc. (Based on the online historical note for Iowans for WOI-TV, Inc., Records, MS 584, Special Collections Department, Iowa State University Library, http://www.lib.iastate.edu/spcl/manuscripts/MS584.html.)*
>
> *In July of 1995, about a year after the television station was sold, President Martin Jischke completed the commitment that President Eaton had made to the WOI Trust biotechnology endowment by designating $2.5 million of the sale proceeds to the endowment.*

As of 1995, there was a Kresge endowment and a WOI biotechnology endowment. The interest from the Kresge endowment was used specifically to support the purchase and maintenance of major pieces of equipment for the instrumentation facilities managed by Biotech. Use of interest from the Kresge endowment for instruments other than the NMR and STEM purchased by the Kresge grant was challenged in 1995 by Marit Nilsen-Hamilton,

Chair of the Department of Biochemistry and Biophysics. The NMR purchased by the grant had been put in her department, and she wanted use of the endowment interest to be restricted to that instrument and the STEM. She founded her challenge on a statement in a letter to President Eaton by Alfred H. Taylor, Jr., Chairman of the Kresge Foundation, on April 20, 1989, that read:

> *The grant is made on a challenge basis to assist you in raising a permanent endowment restricted to the future maintenance and updating of these science facilities.*[3]

She made her appeal to Vice Provost Patricia Swan, who indicated that broader use of the interest for more than the NMR and STEM was appropriate. Marit enlisted the support of Elizabeth Hoffman, Dean of the College of Liberal Arts and Sciences, and David Topel, Dean of the College of Agriculture. A memo they wrote to VP Swan on February 7, 1996, read in part:

> *We are in receipt of your reply to Dr. Nilsen-Hamilton in which you refer to her memorandum of December 31, 1995, regarding documentation supporting an endowment for the 500 MHz NMR. We have examined the associated documentation and find them to strongly support the expectation that there be in existence an endowment restricted to the updating and maintenance of the equipment purchased by that particular Kresge grant. Although one sentence in the grant proposal expresses a broader intent for the endowment, other sentences are more restrictive. . . . Consequently, we are of the opinion that this endowment should be identified and made available for the updating and maintenance of the NMR and the STEM.*[4]

VP Swan's response to the two deans on February 9, 1996, read in part:

> *Thank you for your memo of February 7 raising questions about the use of the endowment associated with the Kresge Foundation Grant. As you know, Marit Nilsen-Hamilton also raised that question to me. As I explained to her, I believe the endowment is to be used to update and maintain major biotechnology instrumentation/equipment. . . .*
>
> *As you probably know, Marit Nilsen-Hamilton has appealed my decision to the Provost. Thus, this matter is now on his desk.*[5]

VP Swan asked me to write to Provost Kozak about my perspective on the issue because I was the one who had direct interaction with the staff of Kresge and wrote the proposal to them. My memo of January 11, 1996, read in part:

> *It is not by chance that we wrote in the grant application that "The interest income from the $2,000,000 endowment to be raised will be used exclusively to upgrade and replace the equipment in the instrumentation facilities for biotechnology". . . .*

I do not know how we would have mounted a fund-raising effort to establish an endowment to support only two instruments. It was clear how we would attempt to raise funds to broadly support the biotechnology instrumentation facilities on our campus.

Vice Provost Swan has interpreted correctly the dialogue that occurred between our university and The Kresge Foundation regarding funds for purchase of the equipment and the use of the endowment interest.[6]

Provost John Kozak concurred with the decision of VP Swan. As a result, the interest from the Kresge endowment has been used to support the biotechnology instrumentation facilities as a whole.

The last endowment supported by Biotech funds was the Wise Burroughs Memorial Endowment in Animal Science. Wise Burroughs was an animal scientist who discovered diethystilbestrol, a growth promotant that was used by cattle producers to increase animal weight gain. The Department of Animal Science had gifts and pledges totaling over $500,000 and needed matching funds. In the fall of 1989, the chair of the Department of Animal Science requested matching funding from Biotech. In October of 1990, Biotech received permission from the Iowa Department of Economic Development to allocate $500,000 of unobligated lottery funds from fiscal years 1988-1990 to the Wise Burroughs Endowment. The endowment is managed by the Agricultural Experiment Station and is used for various research projects related to beef production.

As of June 30, 2009, there are three separate endowments that support Biotech: General Biotechnology, Kresge, and WOI. The value of these endowments for building the biotechnology program of ISU has been enormous. They have been and will continue to be a solid foundation to build on for the future.

Chapter Five
After the Lottery

The $18 million provided by the State of Iowa from July 1, 1985 (FY1986), to June 30, 1990 (FY1990), made it possible for Iowa State University (ISU) to become one of the leading public institutions in biotechnology. The success of the program led to discussions in 1989 about ways to maintain and grow the program after the lottery funds ended.

A key meeting was held early in 1989 in the conference room of President Gordon Eaton. Persons in attendance included the president; Milton Glick, Provost; David Topel, Dean of the College of Agriculture and Director of the Agriculture and Home Economics Station (AES); Norman Jacobson, Associate Provost for Research; and me.

There were two options under consideration for continued support of the biotechnology program. One option was to include a new budget line for biotechnology in the university's request to the State of Iowa for funds to be appropriated for July 1, 1990 (FY1991). The advantage of this option was that the industry representatives had successfully gained the initial support for the program and could be effective supporters of the new budget request. The disadvantage of the option was that it would be in competition with the request for increased funding of the AES. That request was for $3 million in additional appropriations for each of five years beginning July 1, 1989 (FY1990), commonly referred to as the 3 x 5 program. There was the possibility that independent requests for funds for biotechnology and for the AES would not be viewed favorably by the governor and legislature.

The outcome of the deliberations was stated in a memo of March 14, 1989, written by Provost Glick (Appendix 5.1). The memo read in part:

> *We have agreed, per the attached policy, that it will be more effective to incorporate legislative requests for Agricultural Biotechnology within the Agricultural Experiment Station request rather than separately. . . .*
>
> *We have further agreed that of the base enhancement for FY90, at least 40% of this enhancement will be allocated to the Agricultural Biotechnology Council and a similar fraction of the FY91 AES funding enhancement. This is meant to be an on-going base commitment to the Agricultural Biotechnology Council.*

The base enhancement for FY1990 and FY1991 was $2 million each. Of the total $4 million, $1.6 million was provided to the Office of the Vice Provost for Research (VPR) for the Office of Biotechnology (Biotech) beginning July 1, 1990 (FY1991).

One interpretation of Provost Glick's memo was that Biotech might eventually get 40% of the $15 million allocated by the state for the 3 x 5 program. The Council was asked by Vice Provost Patricia Swan to recommend how $6 million would be spent by Biotech. Work on

that budget began on November 21, 1989. It culminated in a memo I wrote to VP Swan on December 19, 1989, that read in part:

> *The purpose of this memo is to report the recommendations of the Biotechnology Council relative to the allocation of future funds for the biotechnology program of the university. At your request, we have discussed in detail how we would recommend allocating $6 million annually for the university-wide program. We appreciated the opportunity to discuss this topic as part of our on-going effort to find creative ways to strengthen the biotechnology program of the university.*
>
> *The Council unanimously agreed that the university could effectively spend $6 million for biotechnology research. In fact, it would be possible to effectively spend more than this if the resources were available.*
>
> *In preparing our recommendation for you, we initially made a list of 14 funding categories. We discussed the amount of funds that should be put in each category and the mechanism by which the expenditures would be made. Throughout the discussion, we sought to maintain the interdisciplinary program approach that has characterized the Council's activities up to this time and to assure that the funds would be spent on a competitive basis as much as possible.*[1]

The dream of $6 million was only that. The $1.6 million received July 1, 1990, became the state allocation for Biotech. In subsequent years, the funds that passed through the AES to the VPR were to be adjusted upward or downward by the approximate percentage increase or decrease in the AES appropriation from the State of Iowa.

Although the strategy described by Provost Glick for securing ongoing funds for Biotech was successful from the perspective of securing additional state support through the 3 x 5 program, the relationship between the AES and the VPR/Biotech was an uneasy one. When the 3 x 5 program was originally developed, the AES assumed that management of the additional funds would be its responsibility. Instead, the funds for Biotech from the 3 x 5 program would be managed by the VPR. As a faculty member in the Department of Agronomy and the College of Agriculture/AES, I was not particularly popular for supporting the position that Biotech was best administered by the VPR to be certain it served all units of the university equally. I felt vindicated years later by an e-mail message on April 15, 2005, from John Pesek who was the former head of the Department of Agronomy and had served as interim dean of the College of Agriculture and interim director of the AES:

> *Providence continues to take care of our blundering in the unknown. At one time, I was quite disappointed and perturbed with the university for chopping off a nascent effort in molecular biology and molecular genetics in our College and for your leaving Agriculture for the greener pastures across the campus. Time has proven your and your superiors' wisdom to consolidate all at the university level. They had extremely good judgment in tapping you to do the leadership, and you had equally good judgment and courage to take on the challenges. Thank you for all, and especially for keeping your hand in soybean improvement.*[2]

The finances of Biotech were stable until we took a major hit on July 1, 2003 (FY2004). I was driving back from the annual meeting of the National Agricultural Biotechnology Council in Seattle the summer of 2003 when I got a cell phone call from VP James Bloedel telling me that Catherine Woteki, Dean of the College of Agriculture and Director of the AES, had requested of Provost Ben Allen that the state allocation for Biotech that passed through the AES be reduced substantially to remedy budget problems of the AES. I asked him when we could meet with the provost to discuss the request. He said the provost had already decided to grant the request and that I would not have a chance to discuss it with him. It was the understanding of VP Bloedel that this would be a one-time budget reduction. That understanding was based on the July 8, 2003, memo of Dean Woteki to Provost Allen that read in part:

> *Office of Biotechnology: The plan proposed by the AES would reduce its support for the Office of Biotechnology by $700,000 beginning in FY04. This would dramatically impact the contribution to faculty start-ups and/or the support for a number of instrumentation facilities. That impact has severe long-term implications for the future of one of Iowa State's key academic interests. To avert that scenario, the Office of the Provost and the Dean of Agriculture will each contribute $100,000 and the Office of Biotechnology will operate with $500,000 less for one year (FY04) while a long-term solution is found to maintain funding for the biotech activities. During this year the Office of Biotechnology will commit and plan for future years (FY05 and beyond) with the understanding that funding will be maintained at current levels, i.e. faculty start-up commitments, which are ordinarily multi-year, will be made.*[3]

The budget and program activities for FY2004 that had been recommended by the Biotechnology Council and approved by VP Bloedel were being implemented by the time the memo was written. To avoid major changes for FY2004, endowment interest reserved for new program initiatives was used to keep the budget at a level similar to previous years (Appendix 5.2). Changes in the program were delayed until a final decision on state funds for Biotech could be resolved.

I asked that VP Bloedel arrange a meeting with Provost Allen to discuss the impact of his decision on the future of the biotechnology program of the university. The meeting took place in August 2003. On August 21, I wrote a memo to the provost summarizing my perspective on the issues that were discussed. The last paragraph read:

> *I hope that the excellence of the biotechnology program administered by the Vice Provost for Research will be continued for many years to come. This will be possible if the state funds that pass through the AES are restored in FY2005.*[4]

On May 17, 2004, Provost Allen wrote an e-mail message to Deans Cheville, Melsa, Whiteford, and Woteki and VP Bloedel that read in part:

> *I have received a few comments as a result of my May 6 e-mail about funding for the Biotech program for FY05. As a result of that input, I propose the following*

modified plan to address the Experiment Station's proposal to reduce its support for FY05 by $700K.

- *The Experiment Station reduce its planned reduction by $100K, i.e. identify other resources of this amount to support the Biotech Program.*

- *The College of Agriculture provide a one-time funds to the Biotech Program of $200K*

- *The endowments provide $350K, thereby eliminating the increase in endowment spending that was proposed at our March meeting for instrumentation facilities, fellowships, public education and bioethics.*

- *The Biotech Program sustain a $50K reduction to its FY04 funding level.*

As a result of this plan, the budget for Biotech for FY05 will be $2,334,600 with the funding sources for that budget coming from:

Experiment Station	*$ 900,000*
Endowments	*1,134,600*
College of Ag	*200,000*
College of Ag/Experiment Station	*100,000*
Total for FY05	*$2,334,600*

With this financial plan in place, I would like to move forward with the proposed program review. I propose beginning that review as soon as possible and asking the following individuals to conduct it for us: Wolfgang Kliemann, Ted Okiishi, David Oliver, Don Reynolds and Wendy Wintersteen.[5]

The task force he referred to in the e-mail message was appointed in a memo on March 1, 2005. It was made up of Wolfgang Kliemann, Associate Vice Provost for Research; Ted Okiishi, Associate Dean of Engineering; David Oliver, Associate Dean of Liberal Arts and Sciences; Don Reynolds, Associate Dean of Veterinary Medicine; Wendy Wintersteen, Senior Associate Dean of Agriculture; and Mary Winter, Associate Dean of Family and Consumer Sciences. His memo read in part:

The charge of the task force is to:

- *assess the effectiveness of the services, programs and support provided by the Office of Biotechnology*

- *recommend a priority for the various activities of the Office of Biotechnology*

- *review the administrative structure of the Office of Biotechnology and suggest changes (if any) to the structure and*

- *identify other possible funding streams*[6]

The task force met with past and current members of the Council on May 18, 2005. The discussion at the meeting was summarized in a memo sent to the chair of the task force, Ted Okiishi, immediately after the meeting (Appendix 5.3).

The report of the task force was not going to be completed in time to impact decisions about FY2005 funding. Therefore, I wrote a memo to President Geoffroy and Provost Allen on May 23, 2005, to which I attached a copy of the memo written to Ted Okiishi on May 18 (Appendix 5.4).

On June 20, 2005, VP James Bloedel forwarded to me an e-mail from Provost Allen to Catherine Woteki and James Bloedel, with cc. to Wolfgang Kliemann, Wendy Wintersteen, and Ellen Rasmussen. The e-mail read:

> *During the FY04 budget development process, Dean Woteki proposed a $700,000 permanent reduction to the experiment station funding for the Office of Biotechnology. The reduction was of sufficient magnitude to generate considerable discussion about the impact of such a reduction and whether a decision of this sort fell within the fiduciary and administrative responsibility of the Dean. Interim plans for funding the Office were developed and implemented for FY04 and FY05 leaving the question of the size of the permanent reduction open.*
> . . . .
> *For FY06 the allocation of experiment station funds to the Office of Biotechnology will be $1,315,736.*[7]

On August 19, 2005, the task force submitted its report to Provost Allen. Because the document included personnel recommendations, it is not included in its entirety here or as an appendix. With regard to the AES funds, the memo read:

> *Given the outstanding success of biotechnology research on campus, the majority of task force members strongly recommend restoration of the portion of state budget allocation through ES to biotechnology research at ISU to $1,368,021 for FY06 as shown in the FY06 budget in Appendix C.*[8]

On September 5, 2005, VP Bloedel was replaced by John Brighton as the VPR. VP Brighton and I met with Provost Allen, after which he wrote a memo to VP Brighton on February 3, 2006, that summarized his decision. With regard to the budget of Biotech, the memo read:

> *The budget allocation through the Experiment Station to the Office of Biotechnology has been restored for FY06 to $1,368,021. This will be the permanent base allocation from the Experiment Station. As the allocation of funds for the Experiment Station changes from year-to-year, the allocation to the Office of Biotechnology may change proportionately.*[9]

With the permanent reduction in state funds that passed through the AES, major changes were made in the biotechnology program based on the recommendation of the Council and the concurrence of VP Brighton.

- Startup funds for new faculty: Before the reduction, it was possible to provide $100,000 for the research of every molecular biologist who was hired by ISU. Beginning July 1, 2005 (FY2006), the amount was reduced to $75,000 for each of seven positions.

- Bioethics: Before the reduction, Biotech fully funded Kristen Hessler as a bioethicist to support activities on- and off- campus. When she left to take a tenure-track position at another university in 2006, her position was not filled. As a result, plans to expand the bioethics program could not be realized.

- Instrumentation facilities: The budget for support of the biotechnology instrumentation facilities was reduced from $987,790 beginning July 1, 2004, (FY2005) to $730,436 beginning July 1, 2005 (FY2006). This was accomplished by reducing the percentage of support from our office to the maintenance contracts of some facilities and reducing the amount of our support for the salaries of some of the facility managers. Those reductions resulted in some increases in the cost of the services for ISU researchers.

- Competitive grants: The competitive grants program that supported new and innovative biotechnology research was permanently discontinued.

- Administration: Before the reduction, 90% of my salary was covered by Biotech and 10% by the Department of Agronomy. After the reduction, 50% of my salary was covered by each unit.

- Technology transfer: Biotech had paid for all of the salary of Lisa Lorenzen, the biotechnology industrial liaison, and half of the salary of her secretary. After the reduction, 50% of the salary of the liaison was paid by Biotech and 50% by the VPR. Support of the secretary was reduced to 25%.

From July 1, 2005 (FY2006), to the present, the state funds that pass through the AES for Biotech have stabilized.

Chapter Six
Space

It is well known that two issues to avoid at a university are parking and space. With the $18 million appropriated by the State of Iowa in the spring of 1986 for the biotechnology initiative at Iowa State University (ISU), it was impossible to avoid getting involved in developing new space that would be required to house new biotechnology faculty, instrumentation facilities, and other program activities. Parking would be left to someone else.

The $1 million in bonds was used to purchase equipment for the establishment of instrumentation (service) facilities and for constructing laboratory space for the research of new faculty in molecular biology. The most convenient area available on campus to build laboratory space with the bond funds was the basement of the new addition to Agronomy Hall. Two spaces in the building considered for molecular biology laboratories were an area designated for soil testing and an unexcavated space in the basement. To utilize the soil testing area, those services would have to be moved to the Agronomy Laboratory Building across the street. That would be expensive because space for soil testing in the Agronomy Laboratory Building would have to be remodeled, and the space vacated in the Agronomy addition would have to be remodeled for molecular biology laboratories. It also would result in a lot of hard feelings.

The decision was made to excavate the space in the basement of the building. Laboratories were designed to accommodate four molecular biologists. The bond funds were considered the purview of the vice president for research (VPR); therefore, the space was under the control of that individual, including assignment of the space. The initial occupants were Alan Myers, Basil Nikolau, Robert Thornburg, and Patrick Schnable.

Even bigger visions for new space for molecular biology research were taking form during the summer of 1986. Prompted by the success of the industry group in securing biotechnology funds, the decision was made to request $35 million for a new molecular biology building (MBB) during the legislative session that began in January 1987. The timing was unusual because the building per se was not on the priority list for capital projects. It also was unusual because there were no architectural plans. Normally, a request for planning funds would be made in one legislative session. If the funds were appropriated, an architect would be hired and plans would be developed during the next year. When all was ready, a request for building funds would be made.

Members of our Industry Advisory Board lobbied hard for the MBB and were successful. On June 9, 1987, Governor Terry Branstad signed "Senate Concurrent Resolution No. 35, A Concurrent Resolution Relating To The Board of Regents Ten-Year Building Program." (Appendix 6.1) I had the pleasure of being invited by ISU President Gordon Eaton to be present for the signing. The resolution authorized $65,600,000 in bonds to be divided as follows. For the State University of Iowa, $25,100,000 for laser laboratories and international center (old law center) remodeling. For the University of Northern Iowa, $3,000,000

for Latham Hall remodeling. For Iowa State University, $37,500,000 for an MBB, home economics building-phase I, meat irradiation facility, university research park development, industrial education remodeling, and veterinary medicine research institute laboratory. Of the funds authorized for ISU, the MBB got $30.5 million.

The building project was assigned to Vice President for Research Daniel Zaffarano. This was unusual because building projects generally were the purview of the dean of the college that was responsible for the department for which it was intended. In this case, the MBB was considered a university-wide resource to be occupied by appropriate faculty members from multiple departments and colleges.

VP Zaffarano asked me to serve as chair of the building committee. It would turn out to be a very satisfying experience for many reasons, not the least of which was because we knew how much money was available from the start. We would not be faced with planning a building and finding out later that funds for construction were less than needed, resulting in an agonizing discussion of what to cut.

The initial planning committee for the project included representatives from the academic departments expected to occupy the new building, the university's office of business and finance, the division of facilities planning and management, and others. The set of planning committee minutes from January 15, 1987, through January 13, 1989, describe the committee's membership and activities.[1]

The architectural firm selected for design of the MBB was Hansen Lind Meyer, Inc., of Iowa City, Iowa. They were assisted by Stanley Consultants of Muscatine, Iowa, and Research Facilities Design of San Diego, California. Story Construction Co. of Ames managed the construction project.

We wanted the building to incorporate the best ideas that were in use in new molecular biology facilities at other institutions. On April 19-21, 1987, members of the committee visited recently constructed buildings in New Jersey at Princeton University and Rutgers University and at the Whitehead Institute in Cambridge, Massachusetts. We gained valuable insight into what features to incorporate into our building. One feature was the use of interior doors to connect consecutive laboratories on the same side of the building, instead of going into a central hallway when moving from one lab to another. This made it convenient for different groups to share space and equipment and to expand or reduce the space for a faculty member over time. A second feature was the use of windows in laboratories where people worked during the day and windowless common spaces in the interior for larger equipment shared by multiple groups.

One key goal of the design process was to have laboratories that could serve existing and future molecular biologists with no remodeling. A common laboratory arrangement also would make the best use of the funds by eliminating unique design and construction costs that would be incurred if each faculty member was allowed to design a laboratory to particular specifications.

It was decided to have two basic designs, referred to as a one-module and a two-module laboratory. The one-module laboratory had one workbench in the center of the room and the two-module design had two workbenches. To provide flexibility in the amount of space a research group would occupy over time, all the laboratories on one side of the building were connected by interior doors. That would make it possible for a group to expand into adjacent laboratories and move readily from one to the other.

To test the acceptability of the proposed laboratory layout, a mockup was built out of Styrofoam and other inexpensive materials in the Meat Lab of the Department of Animal Science that was not in use at the time. Faculty and students were invited to evaluate the design on September 10, 1988, and provide their feedback to the committee. The faculty had differences in the number of fume hoods and sinks they wanted in the laboratories. To accommodate their interests, they were allowed to decide on the number of those two items for their laboratory. The common design for the laboratories has worked very well. New faculty have adapted to the layout and set up their research programs without waiting on laboratory remodeling.

The design of the office space for faculty and students was handled in the same way as the laboratories. The basic layout for all offices was to accommodate up to three persons. There was considerable discussion about the location of the electrical outlets, chalkboard, and tackboard relative to the desks for the three occupants. That discussion was occurring when my family went to Key West, Florida, for spring break in 1988. While my daughter, Susan, and son Steven laid out on the beach, my wife, Elinor, and I drew alternative layouts for the offices in the sand, a very pleasant work environment.

The type of lighting for the offices came down to a choice between conventional overhead fluorescent lights and a style in which the light from the fixture was bounced off the ceiling. The latter design was considered by some to work better with computer screens than direct lighting. Some of us on the building committee conducted a tour of on-campus rooms in which the indirect lighting was used. Although it was attractive, we felt that direct lighting was more efficient for lighting a room. Direct lighting has served us well in the building.

Chalkboard or marker board – that is the question. The committee wrestled with the two options because both of them had merit. The primary advantages given for the marker boards were the lack of chalk dust and the opportunity to use different colors of markers. The primary disadvantage of marker boards was that they were more difficult to maintain, particularly in classrooms with multiple users. I had experience with marker boards in Agronomy Hall. Unlike using chalk, where you could see how much was available, the amount of ink in a marker was unknown, which led to frustration when it ran out and there was no replacement handy. Marker boards were harder to keep clean and became stained if not cared for properly. We decided to use chalkboards in the classrooms and in most of the offices, which has worked well.

The overall design of the building was driven by the desire to have a window in every office and laboratory. To avoid a long narrow building with all the windows on the outside, the architects recommended that we use a rectangular building with a glass-roofed atrium in

the middle. Half of the laboratories would have windows looking out at the atrium's natural light. The committee asked them to proceed with such a concept. The exterior design had to include the building's greenhouses that would be located on the south side for best use of sunlight throughout the year.

After the architects had prepared the exterior design that was acceptable to the building committee, it was presented to the Board of Regents, State of Iowa, (Regents) for approval in December 1987 (Appendix 6.2). They rejected the exterior design because some said it looked like a warehouse, and others thought the design of the glass for the atrium made it look like a ship. The architects went back to work and came up with an alternative that was presented to Marvin Pomerantz, the president of the Regents, and others at his office in Des Moines. As I walked into his office building for the meeting, I noticed that there was a small atrium with natural light that was attractive and welcoming. The boardroom in which we met contained the largest round table I had ever seen. I was afraid that the atrium would not be acceptable because some considered it to be wasted space. I explained that the atrium made it possible for all of the laboratories to have a window that was important for a pleasant work environment and gave the building a welcoming feel, just like the feeling I had when I entered the atrium in his building. After my comments, Mr. Pomerantz looked at me and said, "OK, Fehr, you can have your atrium." The Regents approved the building design at their meeting on July 15, 1988.

The atrium has been a valuable asset for the entire university. The architects developed an attractive design for the walls, stairways, walkways between wings on the same floor, ceiling glass, and lighting. The artist, Andrew Leicester, added to the aesthetics by using ceramic tile to create a piece called "Gene Pool," an image of a bacterium releasing its DNA (Appendix 6.3). My favorite time to see the atrium is at night when the shadows cast by the lights make it an attractive scene. The space is used for poster sessions at scientific meetings held on campus; brown bag lunches over the noon hour, such as those for school children visiting the Biotechnology Outreach Education Center; celebration luncheons, such as those for the 25th anniversary of the Office of Biotechnology (Biotech); the annual Thanksgiving feast for the building occupants; and at least one wedding reception for the daughter of an administrator. When such events are not happening, it is well used by students for studying.

Places for studying, particularly informal meetings of students, were a high priority in the building design. The solution was an interactive area on the north end of the second through fourth floors. To accommodate the areas, the floor was curved out from the north side of the building. The curved glass wall for the area gives the building an attractive appearance as you enter from the north. Comfortable seating and a chalkboard make it a useful student area.

The building was intentionally made larger than what could be finished with available funds to provide room for additional faculty and other program activities in the future. In the basement, space was finished for laboratory animals, electron microscopy, nuclear magnetic resonance, and X-ray crystallography. The west half of the first floor was designed to include an administrative area for Biotech, the Department of Biochemistry and Biophysics, and the Department of Zoology and Genetics; teaching laboratories; a classroom auditorium; and three smaller classrooms. The east half of the first floor had a conference room and space for

the DNA, Hybridoma, and Cell Facilities and plant growth chambers. The second floor was intended for faculty doing plant research, the third floor for animal research, and the fourth floor for enzymology and other basic research.

Once the general features of the building were determined, the detail work began. In April of 1987, Bernard White, a faculty member in the Department of Biochemistry and Biophysics, was asked to spend half of his time serving as the academic program coordinator. He did a masterful job of assuring effective communication among the many groups involved in the detailed design, including the building committee, faculty, university architect, the engineers of Stanley Consultants, and more.

The groundbreaking ceremony was held on a beautiful Saturday morning at the site for the building near the northwest corner of campus. We prepared for each of the guests an orange toy shovel with a label that read "Groundbreaking – Molecular Biology Building – September 10, 1988." I had the pleasure of introducing Norman Jacobson, Associate Provost for Research and Dean of the Graduate College, who served as the master of ceremonies. It was the day before his 70th birthday. The speakers introduced by VP Jacobson were President Gordon Eaton; Governor Terry Branstad; Robert Arnold, majority leader of the Iowa House of Representatives; Marvin Pomerantz, president of the Regents; Nick Frey, member of the Industry Advisory Board for biotechnology and director of technology acquisition and development for Pioneer Hi-Bred International, Inc.; and Bernard White, academic program coordinator. At the end of the formal program, all of the attendees were invited to shovel soil to get the construction started.

With the building construction under way, another committee began its work of selecting someone to design the art. By state law, 0.5% of the funds for construction had to be invested in art, which was $152,500 for our building. The committee to plan the art was independent of the building committee, although a few of us were invited to attend their meetings. The artist chosen was Andrew Leicester, a faculty member at the University of Minnesota in Minneapolis. Leicester wanted to integrate into the art the science of molecular biology and the concerns of the public about it.

Parts of the artwork were not received well by some people destined to occupy the building (Appendix 6.3). They felt that the art led credence to those who opposed molecular biology because it would result in grotesque creatures, like the terra-cotta sculptures on top of the four corners of the building, the 24 terra-cotta medallions on the walls of the atrium, and the female figure in the atrium titled "Forbidden Fruit." I think the toughest one for them to accept was at the north entrance titled "Warning-Biohazard." When the letters in the piece are deciphered, they read, "Human beings are not yet wise enough to direct the course of evolution." I usually paraphrase it by saying, "Humans are not smart enough to mess with Mother Nature."

The dissenters had a chance to air their feelings when we invited Andrew to give a lecture about the art as part of the activities associated with the dedication of the building in 1992. *The Daily Tribune* of Saturday, February 29, put it this way:

For those wondering what the controversy behind the art in the new Molecular Biology Building is about, now is the perfect time to find out.

On Wednesday, March 4, from 7 to 8 p.m., Andrew Leicester, the artist for ISU's Molecular Biology Building, will present a slide lecture titled "The G-Nome Project, Aesthetic and Ethical Issues" in the building's auditorium.

. . . .

Leicester said, "This is my favorite project. It deals with the fundamental issues of life and creation and it deals with our chauvinistic concept that we are more special than other life forms."[2]

The classroom in the building was completely full that evening. Andrew described what had inspired some of the art. For example, the ancient gargoyles on some of the older ISU buildings inspired the medallions on the walls of the atrium. The sculptures on the top of the building represented his concept of a modern-day gargoyle. After the lecture, the comments and questions began.

The Daily Tribune of Thursday, March 5, read:

Controversial art gets cool reception from ISU scientists

Science met art Wednesday night, and like the sculpted hands reaching straight ahead from the new Molecular Biology Building at Iowa State University, the two didn't get close to shaking hands.

. . . .

They [several ISU researchers] *said that although they appreciate Leicester's work they think his wizard-like figures and his depictions of hybrid beasts do not represent the work they'll do in the new building.*

. . . .

Leicester, who's in Ames for today's dedication of the building, smiled and gave answers that spiralled around the questions much like his mosaics depicting the twisty DNA molecule spiral around each of the building's corners.[3]

The editorial board of an Ames newspaper, *The Daily Tribune*, also weighed in on the subject in an editorial published on March 17, 1992, connecting Leicester's art to ethical debates about science.[4]

The criticism of his work seemed to fade rather quickly as it became a major component of campus art (Appendix 6.3). My fear that students would be challenged to scale the building and dress the four sculptures has not happened. The only piece that has been dressed is the female figure in the atrium. Her costumes have included that of a pilgrim for the annual Thanksgiving party, a Hawaiian hula dancer, a snowman, and a Halloween character.

The formal dedication of the MBB was on March 5, 1992, in the atrium. It was held in conjunction with the Agricultural Biotechnology Showcase, March 4-5, and the Life Sciences Symposium, March 6-7, that was part of our technology transfer program with the University

of Iowa and the Iowa Department of Economic Development.[5] The dedication was a major event for the campus and attracted publicity from the news media both before and after the event, including an eight-page advertising supplement as part of the March 5, 1992, *Iowa State Daily*.[6, 7, 8, 9]

A group of us had been working on the program for the dedication ceremony and thought we had it done until we were asked to meet with President Jischke in his conference room on March 2[10]. In a word, he did not like what we had planned. After a major reorganization, he approved the program. Interim Provost Patricia Swan was the master of ceremonies. The speakers were President Martin Jischke; Governor Terry Branstad; Marvin Pomerantz, president of the Regents; Nick Frey, chair of the Industry Advisory Board for biotechnology and product development manager in the specialty products division of Pioneer Hi-Bred International, Inc.; Bernard White, academic program coordinator; and Jennifer Imparl, a PhD student in the Department of Biochemistry and Biophysics. Ralph Rosenberg, the state senator from the Ames district, was scheduled to speak but had to cancel because of duties in the Iowa legislature.

During the dedication, a plaque was unveiled by President Jischke and Stanley Howe of Hon Industries. The plaque that now resides outside the conference room on the second floor reads:

> *THE HON INDUSTRIES CONFERENCE ROOM*
>
> *Iowa State University gratefully recognizes HON INDUSTRIES of Muscatine, Iowa and its Chairman, Stanley M. Howe, '46' for outstanding generosity in providing the office furnishings for the Molecular Biology Building.*
>
> *President Martin C. Jischke*
> *March 5, 1992*

We had assumed that it would be necessary to furnish the building with furniture brought from the buildings where the faculty had been housed. Nobody was looking forward to having old office furniture in the new building; however, completing as many laboratories as possible was a higher priority. It was a wonderful surprise when we learned that Hon Industries was giving $1 million in office furniture to our building.

A group of us went to the company headquarters at Muscatine, Iowa, to discuss the type of furniture available. During that visit, I noticed a toy semi-trailer truck with HON OFFICE FURNITURE on the trailer. I asked one of the hosts what it would take to get one of those. The person answered by taking the truck off the shelf and giving it to me. It has been proudly displayed in my office ever since.

The dedication was a special occasion for me because Elinor, our son Kevin, and my mother, Clara, were in attendance. My mother traveled from her home in East Grand Forks, Minnesota, to celebrate with us. A favorite picture of that day is of the four of us with Governor Branstad and President Jischke.

The celebration did not end with the formal dedication. In the evening, we invited those who played a key role in the building project to a celebration dinner at the Gateway Center in Ames. As part of the program, we handed out plaques with an artist's rendition of the building (Appendix 6.4). I have used Peter Lelonek's plaque in the appendix because he has played a critical role in the building since he joined ISU in December 1990. Peter had been working on the building as a mechanical engineer with Stanley Consultants when VP Swan decided we needed someone to oversee the construction, movement of equipment into the building once it was finished, and management of the space after it was occupied. We were very pleased that someone with Peter's expertise was willing to take the position. VP Swan told me that a person of his caliber probably would not stay at ISU for an extended period of time, but that he would be valuable as long as he was with us. I thought she was right on both counts. Fortunately, we were both wrong and right. Peter proved us wrong by serving as the building manager up to the present. I certainly do not mind being wrong about that. He proved us right by doing an exceptional job of monitoring the construction, moving us into the building, keeping it in top condition, and meeting the varied and changing needs of the occupants.

The program for the dedication dinner included talks by President Jischke; Thomas Pearson, Hansen Lind Meyer; Norman Riis, Story Construction Co.; Andrew Leicester, the artist; and Murray Blackwelder, Iowa State University Foundation. As my last official act as chair of the planning committee for the Molecular Biology Building, I emceed the event. My "script" for the evening is included as Appendix 6.5 as a record of all of those who contributed to the building in one way or another.

The responsibility for decisions about the MBB ultimately rests with the VPR, instead of a college or department. That occurred because the building was intended to accommodate faculty from departments throughout the university who would benefit from working near others with a common interest. Although those intentions were appropriate, they have not been realized to any extent up to the present. Departments have been reluctant to let their top researchers move to the building because that would reduce the interaction among their faculty members. They enticed the faculty members to remain where they were by upgrading their laboratories and equipment. As a result, additional high quality space for molecular biology research has been developed at ISU.

The name of the building has remained unchanged up to the present. There was a suggestion at one time to change the name to honor President Gordon Eaton who was involved in securing funds for its construction. Instead, he was honored in 2002 by naming a new student residence facility as Eaton Hall.

I want to end this chapter by paying tribute to the person who gave his life while working on the building. Gerald "Jake" Lee, 54, died Wednesday, November 15, 1989, at Iowa Methodist Medical Center from an accident during construction. I attended his service at the Schroeder Memorial Chapel in Boone on Saturday, November 18. The room was filled to capacity. We are grateful for his service and that of all of the others who worked without recognition on the construction of the building to make it a reality.

Chapter Seven
Competition

One of the highest priorities for the state funds appropriated in 1986 was to help faculty initiate research in biotechnology, particularly those who previously had not been involved in molecular biology. On April 28, 1986, I sent a memo to Departmental Executive Officers (DEOs) on behalf of the Biotechnology Council (Council) that read:

> *A conference committee of the House and Senate approved funding for agricultural biotechnology at a level of $4.25 million each year for four years. Approval of both houses and the Governor has yet to be secured, but there is a general feeling that they will concur with the decision of the conference committee.*
>
> *I would like us to begin with the program development process. The first step is to determine which departmental executive officers want to be involved in developing the seven general program areas. The DEO will coordinate the input of the faculty of the department in program development.*[1]

The seven program areas were (1) agricultural and industrial product development, (2) animal breeding, (3) animal health, (4) animal growth and development, (5) plant breeding, (6) plant health, and (7) plant growth and development. During May, faculty related to the seven areas met to develop a research plan. At the same time, the Council developed a request for research proposals from the faculty in the seven areas, including requests for new faculty positions. There were 53 proposals submitted by June 30, 1986.

The proposals were evaluated internally and externally. For the internal review, the DEOs selected projects they considered to be the highest priority for immediate funding. Their recommendations were submitted to the Vice President for Research (VPR) and were taken into consideration by the external reviewers. The external reviewers consisted of the Industry Advisory Board and four individuals from other academic institutions. They met on campus August 18 and 19, 1986, to review the proposals. The industry representatives included Ted Crosbie, Garst Seed Co.; Robert Erwin, Sungene Technologies Corp.; Charles Lewis, Grain Processing Corp.; George Barr, Land O' Lakes, Inc.; Christopher Nelson, Kemin Industries, Inc.; Leroy Hanson, Triple "F", Inc.; Nicholas Frey, Pioneer Hi-Bred International, Inc.; Tom Tolbert, Monsanto Co.; John Chrystal, Bankers Trust Co.; and Dean Welch, Salsbury Laboratories. The academic reviewers were Clement Market, North Carolina State University, Raleigh; Eugene Nester; University of Washington, Seattle; Bennie Osburn, University of California, Davis; and Ronald Phillips, University of Minnesota, St. Paul.

The recommendations of the DEOs and the external reviewers were considered by the Council. Fortunately, the priority ratings of the internal and external groups were similar. Sixteen proposals were recommended for funding and Vice President for Research Daniel Zaffarano and President Gordon Eaton concurred. The Board of Regents, State of Iowa, also concurred with the recommendation.

When the Council asked for comments on the process used for the competitive grants program, concern was expressed about the use of DEOs in the review process. Some persons felt that they tended to support the proposals of their own faculty, instead of providing an unbiased assessment. This view was expressed in a March 30, 1987, memo to me from William Kelly, Dean of the College of Sciences and Humanities, which read in part:

> *Last year's procedures, which appeared to involve individuals reviewing their own proposals and/or those of colleagues in their own departments was a poor idea, in my opinion. For example, some DEOs participated in the discussion of proposals from their own department, even their own proposal. I would much prefer the extensive use of external (preferably blind) peer reviewers who are closer to the areas under review. . . . The current system with local reviewers smacks of "you scratch my back and I will scratch yours." Because of this it lacks some credibility.*[2]

Some DEOs felt their time was wasted because the opinions of the outside reviewers dominated the process. Consequently, the DEO committee was not used in the proposal reviews conducted in April 1987 or thereafter. Another change was to reduce the number of program areas of interest from the seven used in 1986 to only three: agricultural and industrial product development, animal research, and plant research. There was a review committee for each area made up of two scientists from other institutions, members of the Industry Advisory Board, and scientists from Iowa State who had not submitted a grant application. The proposals selected for funding were reviewed by the Council to reconcile the amount requested with the amount of available funds. The recommendation of the Council was sent to the VPR for concurrence.

The competitive grants program as just described continued for three years through June 30, 1989 (FY1989). Every year, the Industry Advisory Board and external academics conducted the proposal review. As part of the program for each review session, a representative of each project funded the previous year gave a brief progress report. The process kept the biotechnology program well connected to members of the biotechnology industry.

After three years, the usefulness of the program for stimulating biotechnology research by faculty who previously had not been involved in molecular biology was questioned because an increasing percentage of the proposals were generated by new molecular biologists who had joined the faculty. There was concern that the new faculty members were getting research funds through their startup packages, as well as from the competitive grants program. Another consideration was that as of June 30, 1989, the lottery funds terminated and the future budget for Biotech had not yet been determined. Consequently, the original competitive grants program was terminated on June 30, 1989. The amounts budgeted for competitive grants in FY1991 and FY1992 were to meet obligations incurred in the first three years of the program (Appendix 5.2)

On October 25, 1994, the Council voted to recommend to the VPR that a new competitive grants program be established for high risk research. This time, the biotechnology grants were incorporated into a university-wide research grants program of the VPR that had support from the Roy J. Carver Charitable Trust. It was common to refer to the program as Carver

grants. The guidelines for the biotechnology proposals were similar to, but independent of, those for proposals from other disciplines. The review of all proposals was conducted by internal and external reviewers selected by the VPR. If there were more highly-rated proposals related to biotechnology than funds available from Biotech, some of them were supported by the Carver Trust. The first grants awarded began July 1, 1995.

Biotech was faced with a university-wide budget reversion beginning July 1, 2002 (FY2003). To deal with the reversion, the Council voted on September 25, 2001, to discontinue support for the competitive grants program the next year. The program has not been restored up to the present. Startup funds for new faculty have been considered a higher priority than grants for current faculty.

Chapter Eight
Industry Connections

The biotechnology program at Iowa State University (ISU) has benefitted from a close working relationship with industry throughout its 25 years. In the fall of 1984, various Iowa biotechnology companies generously funded Biotechnology Scholarships in Agriculture that were awarded to 10 high school students who became freshmen in the College of Agriculture the fall of 1985 (Chapter Twelve). Industry actively participated in the first biotechnology showcase in January 1985 and launched an effort that fall to secure state funds for the biotechnology initiative. They were successful in securing $18 million for the biotechnology initiative in 1986 and $30.5 million for the Molecular Biology Building in 1987 (Chapter Two, Chapter Six). Later, they provided support for the biotechnology outreach education program, including funds to construct the Biotechnology Outreach Education Center (Chapter Twelve).

Industry has contributed more than money to the biotechnology program. Their advice to the university as an Industry Advisory Board during the spring of 1986 on how to administer the new state funds played a key role in President Gordon Eaton's decision to place the responsibility with the Office of the Vice President for Research (VPR) and, in turn, the Office of Biotechnology (Biotech) (Chapter Three). Members of the Industry Advisory Board served on the external review teams for the competitive grants program funded by Biotech (Chapter Seven).

The *Iowa State University Biotechnology Update* newsletter has been our primary source of communication with industry and others about the activities of the biotechnology program at ISU. The first issue published on July 22, 1987, read:

> *The Update is not a flashy, full-color publication because, frankly, we're Midwestern and prefer to put every dollar we can into solid biotechnology research and technology transfer strategies.*[1]

We splurged in the April 1989 issue with an upgrade from black print on plain white paper to the use of red in the masthead and titles of articles and printing on glossy paper. That is as extravagant as we have gotten up to the present.

The need to effectively interact with industry led me to suggest to the Biotechnology Council (Council) on July 9, 1987, that we hire a person with corporate experience and expertise in biotechnology to handle technology transfer. The Council recommended to Vice President for Research Daniel Zaffarano that the position of biotechnology industrial liaison be established. The ad for the position in the September-October 1987 *Update* read in part:

> *Primary responsibilities will be to establish and promote opportunities for research collaboration between the biotechnology industry and ISU, industry investment in*

university product development activities, and the location of industrial research and production facilities in Iowa.

. . . .

Minimum requirements are a Master's degree in a biotech-related discipline with considerable experience in university and/or corporate research and management.[2]

The first person hired as biotechnology industrial liaison was Steven Price who came to ISU in January 1988 from Standard Oil in Cleveland, Ohio. Shortly after he joined ISU in January, he and I traveled to Washington, D.C., to promote ISU with an exhibit featuring our biotechnology activities. To minimize transportation costs, we included the cases for the exhibit as part of our luggage. That meant hauling them to the hotel where the meeting was held, setting up the exhibit, and reversing the process to get home. That routine was used for several years, including at one event in San Diego where we were introduced to union workers. By then, the exhibit had grown to the extent that we had to ship it in advance to the meeting site. When we got to San Diego to set up the exhibit, we were told that union workers had to do it. Somehow, we managed to get it done without them. When it came time to take it down, the union leader insisted that they do it. When we told him we could handle it, his response was that we had only one hour, after which they were going to take over. We were done in an hour.

One of the connections that Steve promoted with industry involved the inventions of ISU faculty that were managed by the Iowa State University Research Foundation (ISURF). His close working relationship with ISURF led Vice Provost for Research Patricia Swan to appoint him as the interim director of that unit in 1989. He left ISU in 1994 to join the staff of the Wisconsin Alumni Research Foundation.

Steve's replacement as biotechnology industrial liaison in 1992 was Susan Voynow. She had a PhD in molecular biology/microbiology from the Tufts Medical School in Boston. Although she did not have a background in agriculture, her experience in human medicine seemed like a good fit for some of the biotechnology research at ISU. She wanted to live in the country, so I helped her find an apartment on the upper floor of a farm house near Luther. Living with a farm family seemed like a good way for her to become familiar with agriculture. Although Susan had some fine attributes, we were not able to work well together, so I asked VP Swan for assistance. She agreed to take over as Susan's supervisor, for which I was grateful. Susan resigned her position on June 30, 1995.

It took more than a year to decide if the role of biotechnology industrial liaison was important enough to warrant another search. The Council recommended that the position be filled, and Keith Redenbaugh joined ISU on March 1, 1997. He came to ISU from Calgene, Inc., in Davis, California, where he was the manager of regulatory affairs. He had a PhD in forest genetics from the State University of New York in Syracuse.

Keith traveled extensively in Iowa and elsewhere to build relationships with industry and economic development groups in the state. In June 1998, we traveled together to New York for BIO 98. On the way home, our plane was delayed by weather in New York, which meant we missed our flight from Chicago to Des Moines. The weather in Chicago also was bad,

and the hotels close to the airport were filled with stranded passengers. We had to choose between staying at the airport overnight or taking a taxi to a hotel some distance away. We chose the latter, which turned out to be a big mistake. The taxi driver was sure he knew the location of the hotel with which we had made a reservation. An hour after we left the airport, we realized he was lost. By the time he found the hotel, the meter indicated we owed him a ridiculous amount. He was paid only part of it. After a few hours of sleep, we headed for the airport that was easier to find than our hotel.

Keith decided to return to California in August 1998 and took a job with Seminis Vegetable Seeds, Inc., to deal with their regulatory issues related to genetically engineered vegetable crops. Before initiating a search for Keith's replacement, we evaluated how the biotechnology industrial liaison could better support the activities of the Office of the VPR in its interactions with industry. It was agreed that it would be better for the next biotechnology industrial liaison to work more directly with that office on industry activities, even though the individual would be paid by Biotech.

In 1999, Lisa Lorenzen was hired for the position. She was an ISU graduate with a PhD in genetics and had worked for Pioneer Hi-Bred International, Inc., in research and technology acquisition. VP Swan integrated her into the activities of her office that related to interactions with industry and economic development groups in Iowa communities. Those responsibilities included working with the Office of Sponsored Programs to prepare material transfer agreements and documents related to grants with industry, including those not related to biotechnology. In March 2002, Lisa moved her office from our space in the Molecular Biology Building to those of Vice Provost for Research James Bloedel, and she added the title of Director of Industry Relations. With the change in her duties, the VPR began to assume part of her salary and that of Lisa's secretary beginning July 1, 2003. The change in her salary allocation also was driven by the major reduction in funding for Biotech that began in 2003, and an allocation to the VPR from the state for economic development activities. Although Lisa's contributions to the university are broader than when she began and she has a new title on her business card, we still claim her as our biotechnology industrial liaison.

One of the initial means used to promote interactions with industry was through Biotechnology Showcases. The first one was held January 14-15, 1985, at the Scheman Building at ISU to draw attention to the new biotechnology initiative of the university (Chapter One). As the importance of biotechnology to the economic future of Iowa became more evident, ISU, the University of Iowa (UI), and the Iowa Development Commission formed the Iowa Biotechnology Consortium. The name of the Iowa Development Commission was changed to the Iowa Department of Economic Development (IDED), which is how it will be referred to hereafter. The Consortium held its first Iowa Biotechnology Showcase on September 20-22, 1987. After a Sunday evening barbecue at ISU, the main event started in Ames on Monday, September 21. My daughter, Susan, remembers the occasion very well because she worked as a journalism intern that summer to help prepare the 64-page publication on ISU biotechnology that we distributed. She also pinned a flower on the lapel of Iowa Governor Terry Branstad as he arrived at the Scheman Building on Monday. After visiting the campus, the attendees boarded a train in Des Moines, the

"Biotech Express," for dinner on the way to Iowa City. Tuesday was spent learning about the biotechnology activities at the University of Iowa. A detailed story about the event was included in the August 1987 issue of the *Update* newsletter.[3]

The next Showcase put on by the Consortium took place September 24-26, 1989. The theme was "University/Industry Interaction at Work." The attendees visited both campuses, but this time it was by bus and not by train. The Showcase events continued until the Iowa Biotechnology Association was formed in 1993.

The Consortium also was active in national and international meetings. The November 1987 *Update* newsletter included this paragraph:

> *Consortium at AgBiotech '88*
> *The Iowa Biotechnology Consortium has represented the state in Tokyo, San Francisco, New Orleans, and London. AgBiotech '88, an international conference and exposition for agricultural biotechnology industries, is next on the itinerary. Why is the Consortium traveling to the Washington, D.C., conference in January? Because according to the 1986 USDA Yearbook of Agriculture, "By the year 2000 the worldwide market for biotechnology-derived food and agricultural products could be valued at tens to hundreds of billions of dollars." The Consortium thinks Iowa merits a share of that pie.*[4]

One memorable national meeting took place in July 1986 when Iowa was invited to participate in a seminar in New Orleans sponsored by the Industrial Biotechnology Association. Every state was given the opportunity to present its virtues to the attendees at a one-day seminar. I worked with Bruce Wheaton at UI, persons in IDED, and members of Iowa companies to prepare the Iowa presentation. There was a relatively large number of states on the program and Iowa was somewhere in the middle. After sitting through several of the talks, it became clear that everyone was saying about the same thing. Every state was a great place to locate a biotechnology company. Before it was our turn, Bruce leaned over to me and suggested that we scrap all of the remaining presentations, including our own, say ditto to everything that already had been said, and head to the reception.

It was somewhat surprising to me that the meeting in New Orleans led to an inquiry by Eastman Kodak about locating a facility in Iowa. An economic development group in Cedar Rapids had particular interest in the project and organized a trip to Rochester, New York, to meet with executives of the company. President Eaton invited me to make the day trip with him as a representative of ISU. How do you go to the East Coast for a day trip? You get picked up in the morning at the Ames airport by a private jet belonging to a company in Cedar Rapids, fly to Rochester for the meeting, and fly back that evening. It was the first and only time I have traveled by private jet, but at least I had the chance to learn how the other half lives. The trip paid off when the company built their facility that became Genencor International in Cedar Rapids. The November 1987 *Update* newsletter recounted the details of the story, and one section read:

Plant Is New Market for Corn and Soybeans

The result was Kodak's decision to locate a $50 million plant that uses corn and soybeans in the production of food additives, pharmaceuticals, industrial enzymes, and specialty chemicals on about 80 acres owned by Iowa Electric Light and Power of Cedar Rapids. The plant, which will employ between 75 and 100 persons, is a project of Kodak's Bio-Products Division which originated in 1984 to investigate markets in chemical, biological, and medical areas. Leo J. (Jack) Thomas, senior vice president and general manager of Kodak's Life Sciences Division, says the 150,000-square-foot plant will annually use "thousands of tons of processed corn and hundreds of thousands of pounds of soy-based products in its production process." One of the products, the artificial snow Snomax, is a Kodak product used at ski lodges in the United States and abroad. The plant will utilize fermentation processes to produce additional products in Cedar Rapids.[5]

An example of a payoff from the activities of the Consortium was described in the December 1987 *Update* with the lead article titled "Japan Firm Locates New Biotech Facility in Iowa."[6] The article illustrated the important role that local economic development groups had in attracting companies, which, in this case, were the Boone Industrial Development Corporation and the Boone Chamber of Commerce.

IDED deserves a great deal of credit for promoting Iowa's biotechnology to companies in the US and other countries. The October 1990 *Update* listed 17 events from 1986 to 1990 for which it played a major role in organizing the Iowa presence.[7] Five of them were in foreign countries.

The only overseas trip I made with IDED was to London in May 1987 for Biotech 87. James Roth, a faculty member in veterinary medicine, also represented ISU. After the event, we traveled to Basel, Switzerland, to learn about the research of CIBA-GEIGY. The dinner with the company was memorable when Josef Schuler, a research leader and an ISU PhD graduate, suggested to my wife, Elinor, that she order asparagus as her appetizer. The waitress brought her a dinner-size plate covered with a silver serving cover. When she pulled the cover off, there were about 10 white stalks of asparagus about a foot long each, the largest we had ever seen. They were enough for a meal by themselves. I also learned at that visit that there is a Fehr wine made in Switzerland, which, according to Google,™ is still made today. I have not yet had a chance to sample it. The aspect of CIBA-GEIGY's research that impressed me the most was their investigation of the molecular signals in a plant that tell a cell whether it will be part of a root, leaf, stem, or other tissue. That, for me, remains the most fascinating question in biology. How does nature start with a single cell and end up with a human, flower, or other sophisticated organism?

An early link of ISU to industry was through our membership in the Association of Biotechnology Companies. We also had a chance to interact with programs in other states through their section called the Council of Biotechnology Centers. ISU was one of the first universities in the US to have an exhibit at their annual meetings.

The Association of Biotechnology Companies and the Industry Biotechnology Association merged in 1993 to form the Biotechnology Industry Organization (BIO). The ISU-only exhibit at the annual meetings of the industry organization was replaced by a large display including UI, IDED, and Iowa companies. To gain even more visibility for the state, IDED decided to be a major sponsor of the night devoted to games and entertainment for all the attendees at BIO meetings. It was a lavish event at which those of us from Iowa were the hosts.

One of the most memorable of the BIO events took place in March 2000 in Boston. That meeting was held at a time when anti-biotechnology forces were particularly active. The police in Boston were not about to let things get out of control. The anti-biotechnology activities were restricted to a park near the conference center that was surrounded by police. At one evening event, there was a police helicopter with a spotlight hovering over the entrance of the building where a small anti-biotech group had gathered. The police surrounding the group looked imposing to me because of their size and dress. They were tall men who wore tight black boots that came up to their knees, wide black belts that crossed over their chests, helmets, and weapons around their waists. There were plain clothes officers in the building who, theoretically, were supposed to be inconspicuous, but the bulge of the weapons under their suit coats and their constant catlike glances around the room made them stand out from the rest of us. With all of the police presence, the meeting was conducted without any serious confrontations.

It was at the same meeting in Boston that there was an entertaining incident involving Iowa Governor Tom Vilsack. He was there because IDED was a major sponsor, which gave our state certain privileges for connecting with the attendees. IDED had a reception for the Iowa attendees that the governor attended. I was sitting next to the wife of the president of an Iowa company. The governor made his rounds to greet everyone. When he held out his hand to greet the woman, she said "And who are you?" The governor smiled and said, "I am Tom Vilsack, the governor of Iowa." No need to describe how the lady felt.

The biotechnology industry in Iowa united in 1994 to form the Iowa Biotechnology Association (IBA), one year after the national Biotechnology Industry Organization was formed. Its formation was spearheaded by Myrt Levin of the Iowa Business Council and some Iowa companies. Myrt was IBA's first executive director, and Tom Pekich of Genencor International in Cedar Rapids was the first chair of the board of directors. Myrt was replaced by Douglas Getter, the current executive director of the IBA. ISU has been an active part of the organization since it was founded. As the ISU representative to the organization since its inception, I have been impressed by the effectiveness of the organization in presenting the views of the industry to the governor and legislators of Iowa. Because of its lobbying activities, ISU and other academic institutions in the state are *ex officio* members of the board and do not vote. That has not hindered our interaction with the organization. Lisa Lorenzen, in particular, has contributed significantly to their activities. She organized biotechnology mixers that brought companies together to promote interaction among them, career fairs at ISU to give companies and students a chance to interact, and played a major role in developing the programs for the annual meetings of the organization. The IBA has supported the ISU biotechnology program by offering stipends for teachers attending our

workshops and by organizing a state-wide purchasing consortium to reduce the cost of equipment and supplies for ISU and member companies of IBA.

Recognition of the role of ISU in economic development and the need for effective interaction with industry has changed substantially in the past 25 years. The most prominent symbol of this change is in the title of the person to whom the Office of Biotechnology reports. The title of Vice President for Research and Dean of the Graduate College in 1984 has become the Vice President for Research and Economic Development. The interrelationship of teaching, research, and economic development is well understood today.

Chapter Nine
Expanding the Talent

One of the most dramatic changes in biotechnology at Iowa State University (ISU) that resulted from the state appropriation was the addition of 129 new molecular biology faculty from the spring of 1986 to June 30, 2009. This dramatic change was the result of a cooperative effort between the Office of Biotechnology (Biotech) and the departments of the Colleges of Agriculture and Life Sciences, Engineering, Human Sciences, Liberal Arts and Sciences, and Veterinary Medicine.

The emphasis on hiring molecular biologists was consistent with the definition of biotechnology developed by the Biotechnology Council (Council) for Vice President for Research Daniel Zaffarano. The definition recommended at its meeting of September 12, 1986, was "The application of molecular biology to the development of useful products." VP Zaffarano liked the definition but added "and processes" at the end. "The application of molecular biology to the development of useful products and processes" has been the working definition since that time. It has been extremely important in defining the role of the biotechnology program within the broad field of biology.

Two options were considered in 1986 for use of biotechnology funds in faculty hires. One option was to provide the salary for new hires. This option was presented by members of industry to legislative leaders in a letter of April 22, 1986 (Appendix 2.1). One weakness of this option was that it would tie up a major part of available funds for an extended period of time and reduce support for other important activities.

The second option was to let the departments and colleges cover the salaries of new faculty and use biotechnology resources to provide startup funds for them. Until 1986, faculty members generally were provided with limited startup funds. As a result, they spent a significant amount of time during their first years at ISU writing grants to obtain the resources necessary for research, instead of immediately initiating a major research effort with startup funds provided by the university.

There was general agreement that the second option would best serve the university in the long run. Under this arrangement, the departments and colleges were free to hire whomever they wanted to fill a faculty position. If they chose to hire a molecular biologist, Biotech would contribute to the startup package. This strategy has worked very well in hiring and supporting the new molecular biologists, the majority of whom are still at ISU (Appendix 9.1).

The first budget for Biotech began July 1, 1986 (FY1987). That budget included $1.2 million for startup support. A budget line for startup funds has been maintained every year since. The six molecular biologists hired in 1986 each received $150,000 in startup support. They were Thomas Ingebritsen in the Department of Zoology, Michael Lee in the Department of Agronomy, Alan Myers and Robert Thornburg in the Department of Biochemistry and

Biophysics, and F. Chris Minion and Donald Reynolds in the Veterinary Medical Research Institute.[1]

One of the most coordinated efforts in faculty recruitment at ISU occurred in 1987 when 10 tenure-track positions in molecular biology were advertised in a full one-page ad in *Nature* and *Science*.[2] The ad was intended to tell the world and prospective candidates that ISU was on the move in molecular biology. The Biotechnology Council (Council) recommended on September 26, 1986, that Biotech pay for the ad and the departments pay for the cost of the interviews. At that same meeting, they recommended that three criteria be met for each position to encourage the hiring of molecular biologists who would impact more than the hiring department:

1) *A member of the Biotechnology Council will serve on the search committee.*
2) *The search committee membership must be interdepartmental.*
3) *The position must fit into the focus areas identified by the university.*[3]

The first two of those criteria became part of the procedure that was developed for making positions eligible for biotechnology startup funds. Before the position was advertised, a representative of the department was asked to meet with the Council to review the position description and proposed advertisement. The department was asked to obtain letters of support for the position from other units in related areas to further encourage the hiring of individuals who could strengthen multiple departments. Based on that information, the Council made a recommendation to the vice president for research (VPR) on whether to make the position eligible for startup funds. Even if the recommendation was favorable, accessing the funds was still contingent on identifying an appropriate molecular biologist. A member of the search committee was selected by the department from the members of the Council. The selected Council member could not be from the hiring department. During interviews, the candidates met with the Council representative and me whenever possible.

After the department selected the candidate, it presented the credentials to the Council. The criteria established by the Council for its evaluation currently read:

a) *The individual should be a molecular biologist whose past and current research activities and publications provide evidence of the ability to conduct molecular biology research.*

b) *The individual should have sufficient time to conduct independent research for which he/she can serve as the principal investigator.*

c) *The individual should provide evidence of interest in integrated and multidisciplinary research in molecular biology.*

d) *The individual should be willing to develop interactions with other ISU faculty who also are conducting molecular biology research.*[4]

If the Council considered the individual to be a qualified molecular biologist, it recommended startup funds. The VPR had to concur with the recommendation before funds were made available from Biotech.

The departments generally have followed the procedure well and the process has gone smoothly. There have been a few times when a candidate with molecular biology credentials unexpectedly was identified in the search for a position that was not made eligible at the beginning of the hiring process or there was a directed search for a candidate that did not involve a general solicitation of applicants. In all of those situations, the Council has agreed to consider the candidate for funding based on the four criteria listed above.

The Council often was asked to explain how it would determine if an individual was a molecular biologist. This was particularly true when a department was defining a position broadly, such as an organic chemist, an evolutionary biologist, or a plant breeder. One lighthearted answer to the question was that we will know one when we see one. Despite the lack of a specific set of criteria for defining a molecular biologist, there was general consensus that an individual had to be using modern molecular techniques in the laboratory to answer biological questions.

Over the years, there have been relatively few cases in which the Council members were not unanimous in their recommendation to the VPR. Any disagreements centered on whether or not the candidates had adequately demonstrated that they were competent to conduct a research program in molecular biology that addressed a biological question. When there have been disagreements, I noted it when the recommendation was forwarded to the VPR for approval. The VPRs have supported the majority vote of the Council members for all candidates, except in one instance. It was a situation in which the Council members could not agree if the molecular biology credentials of an individual were strong enough, and the majority of the Council recommended that Biotech support not be provided to the individual. The VPR decided instead to provide the support requested by the department.

The Council received some criticism for the strong emphasis on molecular biology, instead of more broad support for biology as a whole. The criticism was that the availability of startup funds from Biotech inappropriately encouraged departments to hire molecular biologists because startup funds for non-molecular biologists were hard to find at the university. The Council understood that the funds influenced the type of individual hired, but it did not change the criteria because the biotechnology program was designed to specifically strengthen the capacity of the university in molecular biology. It also realized that available funds were not adequate to support biological research more broadly.

The resolve of the Council has been tested in recent years with the growing importance of bioinformatics. A strong case was made for making candidates in bioinformatics eligible for startup funds because their research is important for interpreting molecular data. Despite this fact, the Council recommended that individuals would only be eligible for startup funds if at least part of their time was devoted to research in a wet laboratory. Their recommendation turned out to be a wise one when Biotech had to absorb a major reduction in funds in recent

years that has made it difficult even to provide startup support for persons with laboratory research programs.

From 1986 to 2000, the amount a department could request from Biotech was up to $150,000. Rarely was the request for less than the maximum. When the number of hires increased, the amount offered by biotechnology was reduced to $100,000 per position beginning in February 2000. When the decision was made by Provost Benjamin Allen to permanently reduce state funds that passed through the Agricultural Experiment Station to Biotech, the amount decreased to $75,000 per position beginning in August 2006, and the maximum number of positions that could be provided startup funds per fiscal year was limited to seven. During the academic year of 2006-2007, the first seven positions filled utilized all of the available funds beginning July 1, 2007 (FY2008). The additional hire that year was not able to access his startup funds until July 1, 2008 (FY2009). That left only enough funds for six more positions that would be filled as the result of searches during the 2008-2009 academic year. There was concern that, for the first time, it would not be possible to provide support for all of the molecular biologists who were hired.

There always had been a question of what would happen if the number of candidates eligible for startup funds exceeded the budgeted amount for any year. Until the major budget reduction that the program sustained beginning July 1, 2003, the question never had to be answered because interest funds from endowments could be carried over from year to year. Those reserves were particularly important one year when 11 individuals were hired and the budget included funds for only seven new hires.

The flexibility for providing more startup funds than budgeted for a year ended when all of the interest funds held in reserve to deal with unexpected circumstances were used to handle the budget reduction that began July 1, 2003. I informed Interim Vice President for Research Theodore Okiishi and Associate VP Charlotte Bronson of the potential problem that could occur with startup funds for hires during the 2008-2009 academic year so that VP Okiishi could take it into consideration when allocating funds from his office for startup.[5] This was an issue for his office because, beginning with VP James Bloedel, the office had indicated to departments that the VPR would provide 40% for every startup package of individuals in any discipline. The funds from Biotech were considered part of the 40% provided by the VPR to molecular biologists. When John Brighton became vice president, he reduced the percentage to 30%, but he continued to count the funds from Biotech as part of his 30%. VP Okiishi continued that strategy when he became the interim vice president in June 2008. Consequently, if Biotech did not have enough funds to cover all of the requests for startup funds for molecular biologists for hires during 2008-2009, the VPR would have to cover the full 30% promised to the departments for any candidate.

To further complicate the situation, a Council member appropriately questioned if the amount of time required to evaluate candidates for Biotech funds was worth it when individuals would get 30% from the VPR, regardless if they were molecular biologists. To deal with this concern, I met with VP Okiishi and Associate VP Bronson on July 9, 2008, and requested that the biotechnology funds for startup be considered independent of any funds from their office. After evaluating my request and the overall budget situation for their

office, they decided that they would consider startup funds from Biotech independent of the resources they provided to individuals. They also implemented a plan to provide startup funds on a case-by-case basis across the university, instead of using a flat percentage for a startup package. In the end, no problem occurred with startup funds for hires during the 2008-2009 academic year because the recession significantly reduced the number of available positions.

Although Biotech has had the policy of not permanently funding the salaries of new faculty, departments and colleges were given the opportunity to request bridge funding for a limited period of time for positions considered critical to the university. Two positions were supported with bridge funding. Biotech and the Center for Integrated Animal Genomics jointly provided bridge funding during FY2006 to FY2008 for a faculty position in the Department of Ecology, Evolution, and Organismal Biology. From FY2007 to FY2009, Biotech teamed with the Laurence H. Baker Center for Bioinformatics and Biological Statistics to support a faculty position in the Department of Statistics.

As this historical record closes on June 30, 2009, the number of "card carrying molecular biologists" at ISU has grown about tenfold from what it was in 1984, and the perfect record of providing startup funds from Biotech for every new molecular biologist remains intact.

Chapter Ten
Start-of-the-Art

The lack of state-of-the art instrumentation for biotechnology research was one of the primary areas addressed in seeking funds from the state for the biotechnology program at Iowa State University (ISU). In 1984, the only two facilities on campus to support biotechnology research were the Protein Facility and the Bessey Microscopy Facility. Today, there are a total of 28 facilities listed in the publication *Service Facilities for Research in Biotechnology*, 13 of which receive financial support from the Office of Biotechnology (Biotech). This chapter will focus on those 13 facilities, referred to over the years as instrumentation, service, or core facilities. New services offered by the facilities have been described in *The Innovator*, a newsletter about the instrumentation facilities that was first published on October 31, 1995.

A background document I wrote for the Biotechnology Council (Council) in November 1985 relative to the request for funds from the State of Iowa read:

> *With regard to support of the existing faculty, the University lacks some major pieces of equipment that are necessary for innovative research in biotechnology. One example of such equipment is a machine that can synthesize DNA molecules with prescribed sequences. Most institutions have one or more of these instruments to service the faculty. Iowa State University has none. Another vital piece of major equipment for biotechnology will make it possible to determine the sequence of amino acids in protein molecules. Major universities consider this an essential piece of equipment to support their faculty. Iowa State University has none.*[1]

I wrote another document for the Council that was requested by Iowa Governor Terry Branstad after members of industry met with him on November 26, 1985. Its purpose was to describe our vision for a center of excellence in agricultural biotechnology at ISU. It read:

> 1. *Research instrumentation centers – Biotechnology research and teaching requires access to expensive pieces of equipment. At present, Iowa State University lacks major equipment items, which significantly retards the ability of the faculty to be at the forefront of science and which prevents adequate training of students. It is the recommendation of the Biotechnology Council that major pieces of equipment be purchased for use by the entire university, rather than for each college or department. The three instrumentation centers of highest priority would be for proteins, recombinant DNA, and cell biology.*[2]

When it seemed likely that ISU would be granted funds from the state in the spring of 1986, I prepared a document on April 14, 1986, on behalf of the Council that proposed the establishment and operation of a biotechnology institute at ISU. With respect to instrumentation, it read:

The activities to be supported with funds from the institute include the following:

A. Instrumentation Laboratories
The institute will establish, equip, and operate university-wide instrumentation laboratories for major pieces of equipment or for services that are needed by a number of scientists. The faculty will be surveyed to determine the equipment and services that should be offered by the laboratories. A fee will be charged for use of the laboratories, but they will not be self-supporting. The laboratories will be available, as time permits, to research staff of other state institutions, private colleges and universities, federal agencies, and private companies. (Appendix 3.1)

On June 13, 1986, the Council decided to form an instrumentation committee. The minutes read:

An Instrumentation Committee will be formed, with John Mayfield as chair. The committee will include the faculty leader of each of the proposed instrumentation laboratories, a representative from REAP [Research Equipment Assistance Program]*, RTAG* [Research Technical Assistance Group]*, the National Animal Disease Center, the National Veterinary Services Laboratories, Pioneer, and ICI/Garst. The committee will recommend to the Council action relative to establishment and operation of instrumentation services for scientists in the university, federal agencies, and the private sector.*[3]

The Instrumentation Committee provided valuable input on the instrumentation capabilities that needed to be developed at ISU. Their work was the beginning of a process for providing researchers with state-of-the-art instrumentation. The facilities that were established will be discussed in chronological order relative to the date when funds from Biotech were first provided to them.

Flow Cytometry Facility (formerly Cell Sorting Center, Cell Facility)
The first university-wide facility supported with funds from the biotechnology program was for flow cytometry. On June 6, 1986, the Council voted to fund a staff position to operate a new flow cytometer acquired by a team of ISU scientists through a $256,000 grant from the National Institutes of Health (NIH). The facility was first referred to as the Cell Sorting Center with Carol Warner from the Department of Biochemistry and Biophysics as the professor-in-charge and Vickie Hall as the manager. The instrument was initially housed in Gilman Hall.

When Carol Warner left ISU, Marit Nilsen-Hamilton of the same department assumed the role of professor-in-charge in late 1988. James A. Olson, also a faculty member in the Department of Biochemistry and Biophysics, became the professor-in-charge in 1990. When he took a faculty improvement leave beginning in the summer of 1991, Stephen Ford from the Department of Animal Science was appointed as the professor-in-charge for a year. When James asked to be replaced in March of 1994, Stephen again was appointed as the professor-

in-charge, a position he held until he left ISU in 2001. The current professor-in-charge, Michael Wannemuehler from the Department of Veterinary Microbiology and Preventive Medicine, succeeded Stephen in that capacity.

Kristi Harkins replaced Vickie Hall as the manager in November 1990. In 1992, she moved the facility to the Molecular Biology Building. During 1993, the services of the Cell Facility and the Hybridoma Service were merged into the Cell and Hybridoma Facility with Kristi as the manager. When Kristi left ISU in 2000, the facility was divided into two units, the Cell Facility and the Hybridoma Facility. Donghui Cheng was the manager of the Cell Facility until he left ISU in March 2002. Shawn Rigby, the current manager, began his work at ISU on August 5, 2002.

In 2008, the name of the Cell Facility was changed to its current one. The facility has gone out of its way for many years to meet the needs of the faculty and students on the main campus and at Veterinary Medicine. In October 2000, they established a satellite location in the Veterinary Medicine Complex to house a FACScan cytometer. In 2009, the facility established collaborations with the National Animal Disease Center to provide access for our faculty to a flow cytometer that we could not justify purchasing for ISU because it would not be used sufficiently.

DNA Facility (formerly Nucleic Acid Facility, DNA Sequencing and Synthesis Facility)
On July 3, 1986, the Council recommended the establishment of a Nucleic Acid Facility under the leadership of Robert Benbow as professor-in-charge. Robert was a faculty member in the Department of Zoology and Genetics. The facility was initially located in Science II. It moved to the Molecular Biology Building when it was completed in 1992. The name of the facility was changed to DNA Sequencing and Synthesis Facility in the spring of 1994 and shortened to its current form in the spring of 2005.

The initial purchase of equipment was for manual DNA sequencing. Two decisions on additional purchases were delayed by the Council on July 3, 1986, as described in a memo I wrote on July 8 to Vice President for Research Daniel Zaffarano and Associate VP Norman Jacobson. Two key principles were embodied in the discussion about the additional purchases that are still considered of primary importance when addressing new instrumentation. The memo read in part:

> 3. *The Council authorized the solicitation of bids for an oligonucleotide synthesizer. Final approval for the purchase will depend on documentation that the synthesis of all oligonucleotides should be done on this campus, rather than utilizing the current center at the University of Iowa. The council wants to be certain that we are not criticized for purchasing equipment which we could satisfactorily share with one of the other Regent institutions.*
>
> 4. *The Council delayed action on the purchase of an automated DNA extractor until there is clear evidence that there are a sufficient number of investigators on campus who would utilize the equipment.*[4]

A very difficult period for the DNA facility began on January 21, 1992, when Robert Benbow asked the Council to approve a salary increase for the manager, John Bell, who had received an offer from San Diego State University to set up a nucleic acid facility. Council member Peter Reilly made a motion to defer action on the request until questions about the finances of the facility could be answered. He asked for copies of their fee-for-service (202 account) statements for 1991 and an explanation of expenditures. Accounting for the facility was done by the Department of Zoology and Genetics. I had serious questions about the appropriateness of expenditures that were being made. Those concerns led me to ask the Council to remove Robert as the professor-in-charge of the facility.

On January 30, 1992, Robert sent a memo to the Council titled "Dr. Fehr's call for a change in the leadership of the Nucleic Acid Research Facility (NARF)." On February 4, he met with the Council to answer questions, following which it was decided to have a special meeting to review the facility. I asked the Council to select one of the members to chair the review because I had strong feelings about the matter and did not believe I could objectively deal well with the analysis that would be required. Prem Paul was selected as the chair of the subcommittee.

There were multiple meetings of the Council to discuss the issue, none of which I attended. In April 1992, the subcommittee presented its report to Interim Vice Provost for Research John Dobson in a document titled "Operating Policies for the Biotechnology Instrumentation Facilities at Iowa State University" (Appendix 10.1). It indicated that facilities receiving support from Biotech should report to the Council and not to the department of the professor-in-charge or a user committee. The director of Biotech should serve as the departmental executive officer for persons hired on state funds for biotechnology, for approval of purchases on state funds, and other relevant matters. Persons hired to operate facilities should be employees of Biotech and not the department of the professor-in-charge. Funds received for services by a facility would be used only for operation of the facility. Each facility would have a User Committee to provide input to the manager and professor-in-charge of the facility and the Council. The recommendations of the subcommittee approved by VP Dobson have been used ever since for management of the facilities.

The recommendation of the subcommittee led to a transfer of financial accounting responsibilities from departments to Biotech. The staff of the office handled the additional responsibilities as best they could until a review of accounting practices in the facilities by the internal auditor in the Office of the President identified weaknesses that could only be overcome by hiring a full-time accountant. The first full-time accountant for the instrumentation facilities, Debbra Matney, was hired in August 1994. Through her work with the internal auditor, an accounting procedure was established that included a detailed justification of the rates charged for services. Since that time, the rates of every facility have been reviewed in detail in May and June of each year by the facility manager, the professor-in-charge, the accountant, and me. The review assures that the charges made for services are as low as possible for ISU faculty and that none of the facilities have a negative balance. Our procedure is considered by the VPR to be the model that other service facilities should try to emulate.

While the deliberations were under way about the management of the facility, John Bell left ISU. I took over the responsibilities of professor-in-charge of the facility in 1994 as the replacement for Robert Benbow. Melvin Duvall was hired as the replacement for John Bell but was at ISU only from March to December of 1993. He left ISU to assume a tenure-track position at another university.

When Harold (Hal) Hills became the manager of the facility in 1993, the reputation of the facility grew nationally and internationally, which led to an increase in staff, new instrumentation, and a positive financial balance. I enjoyed working with Hal, but that was not true for some of his staff. By May 1997, I had no choice but to remove him as manager and appoint Gary Polking, one of his staff members. Hal continued working in the facility until he left ISU in March 2001 to manage a nucleic acid facility at another university.

Problems in the DNA Facility ended when Gary became the manager. He has excellent interpersonal skills that are appreciated by the staff and clients of the facility. Under his management, the facility has continued its reputation for quality work. He has been very effective in acquiring new instrumentation, largely with financial resources derived by work for off-campus clients. Gary also is the coordinator for the 542 course Introduction to Molecular Biology Techniques.

Protein Facility

The instrumentation available for protein research in 1984 was in the Department of Biochemistry and Biophysics located in Gilman Hall. The facility had been in operation for about 20 years and provided services with a Beckman amino acid analyzer and peptide synthesizer. On October 31, 1986, the Council voted to join with the Department of Biochemistry and Biophysics to establish a university-wide Protein Facility by authorizing the purchase of an ABI amino acid analyzer. Donald Graves of that department was the first professor-in-charge of the Protein Facility and Shirley (Sayre) Elliott was the first manager. Donald was replaced on July 15, 1989, by a colleague in his department, Louisa Tabatabai. She supervised moving the facility from Gilman Hall to the new Molecular Biology Building in 1992.

When Shirley Elliott left in 1994, Louisa served the dual role of professor-in-charge and manager. She also provided exceptional service by advising faculty and students on their protein research projects. When she was no longer able to fill those roles in 2005 due to increased responsibilities at the National Animal Disease Center, I assumed the role of co-professor-in-charge along with the chair of the Department of Biochemistry, Biophysics, and Molecular Biology (BBMB). Joel Nott, who had worked in the facility since 1993 when he was an undergraduate, was appointed to his current position of manager in 2004.

The early years of the involvement of Biotech in the Protein Facility were somewhat rocky. One memorable occasion was when I had to settle a dispute over which of the full-time employees had authority to get the mail from the mailboxes in the Molecular Biology Building. Fortunately, that is the most serious personnel issue I had to deal with in the facility. Of greater significance was the review of the finances of the facility by the internal auditor in the President's Office. I had raised questions about the financial operation of

the facility in 1989 when I learned that the rates charged to the clients for services were not consistent. During the review by the internal auditor, notes were found indicating that services had been performed that were never billed to clients. Shirley Elliott, Donald Graves, and some of the users met with the Council on June 6, 1989, to review the matter. Everyone was very cooperative in establishing a uniform rate schedule for all users and adopting acceptable accounting procedures. The same spirit of cooperation between the department and our office has been present in all of the decisions that have had to be made over the years as technology for protein research has evolved.

The facility has many off-campus clients, including the University of Iowa (UI). Since UI closed their facility, the researchers have used our Protein Facility at the same rates as ISU faculty. The directory of instrumentation services on the Web site of UI lists our Protein Facility.

There was some concern about duplication of services when the Plant Sciences Institute (PSI) decided to develop a Proteomics Facility. As a result of discussions with Stephen Howell, the director of PSI; Joel Nott; and faculty involved in protein research, the instrumentation and services established in their facility complement those in our facility.

A valuable lesson in the purchase of new instrumentation occurred when the Protein Facility requested funds to purchase a ProteomeLab™ PF 2D. A survey of the faculty indicated that there were some potential users; however, there was concern if enough of the potential users would become active users to support maintaining and operating the instrument. I contacted the University of Minnesota to find out if it would be possible for them to provide service work for our faculty on their instrument. They agreed to do so. The Council recommended that we subsidize the cost of work done at the University of Minnesota so that the rate would be comparable to what it likely would cost at ISU. None of the ISU faculty ever used their service. As a result, we averted the purchase of a costly instrument at ISU that would have been underutilized.

Fermentation Facility

A Fermentation Facility was first discussed by the Council on February 13, 1987. Peter Reilly reported on a grant from the National Science Foundation (NSF) that would support the facility. It was formalized as a university-wide facility on July 30, 1987, with the appointment of Peter Reilly, Department of Chemical Engineering, as professor-in-charge.

The facility has been a cooperative effort of several administrative units. The facility has always been closely aligned with the Department of Food Science and Human Nutrition and the Department of Chemical Engineering. Biotech has provided part of the salary of the manager and funds for equipment. Although the financial account is now maintained by the Department of Food Science and Human Nutrition, its activities and rates are reviewed each year in the same manner as the other Biotech facilities.

John Strohl has been the manager of the facility since 1994. Bonita Glatz assumed the role as professor-in-charge after Peter Reilly in 1990. In 1994, she was replaced by Anthony (Tony) Pometto III who served until he left ISU in 2008. Since then, the professor-in-charge of the

facility has been Lawrence Johnson, director of the Center for Crops Utilization Research and the BioCentury Research Farm.

Image Analysis Facility
Establishment of an Image Analysis Facility was first discussed by the Council on February 22, 1988, when Carol Jacobson in the Department of Veterinary Anatomy presented a request for equipment, service contracts, and technical support. The Council recommended approval of the request to establish the facility to be located in Veterinary Medicine. Carol and Larry Arp in the Department of Veterinary Pathology agreed to serve as the co-professors-in-charge. Undergraduate and graduate students initially were hired to provide the services of the facility. In August 1989, Margaret Carter was hired as the manager, a responsibility she continues to have today. Larry Arp left the co-professorship position in 1990, and Carol Jacobson left in 1996. Mary Helen Greer assumed responsibility as professor-in-charge until later in 1996 when Mark Ackermann, the current professor-in-charge, assumed that responsibility.

Joel Nott, the current manager of the Protein Facility, began working half-time in the Image Analysis Facility and half-time in the Protein Facility in January 1995. As part of his responsibilities in the Image Analysis Facility, he provided computer support to other service facilities and to Biotech, something he continues to do. To better serve users on the main campus, a satellite facility was located in the basement of Kildee Hall.

Use of the equipment in the facility began to decline as imaging equipment and software became more commonplace. To adjust to the reduced demand, the satellite facility in Kildee Hall was closed, Margie was hired half-time by Mark Ackermann for his research, and Joel devoted all his time to the Protein Facility. The instruments were moved from Veterinary Medicine to the basement of the Molecular Biology Building when the Confocal Facility was moved in January 2009. Margie continues to make the service available from her new location.

Microscopy and NanoImaging Facility (formerly Bessey Microscopy Facility)
Discussions by the Council regarding support for electron microscopy were first recorded on February 7, 1989. That discussion followed a report of an EM Center Study Committee written to VP Zaffarano on April 13, 1988. The report read in part:

> *Iowa State University has a long history of providing electron microscopy for researchers in the areas of the life sciences, material sciences, and engineering. The first electron microscopes appeared about 1960 in physics, engineering and the life sciences, and today number in the twenties. These instruments are situated on the campus in thirteen facilities that serve almost all areas of science and engineering. Unfortunately, a majority of the instruments are old and obsolete, and no longer are able to provide quality results essential to being competitive in today's high technology era.*[5]

By 1989, the Council had adopted the philosophy that financial resources for instrumentation should be directed to one university-wide facility for each research area. Instead of trying to

upgrade the instrumentation for electron microscopy in multiple locations, it recommended that resources should be put into the Bessey Microscopy Facility. That recommendation was supported by VP Zaffarano because his office was providing financial support to the facility. In 1984, it was financially supported by the VPR, the College of Sciences and Humanities, and the Department of Botany. Harry Horner, a faculty member in the Department of Botany, had been the professor-in-charge since 1970, a position he has held continuously up to the present. The status of the facility 25 years ago was provided on October 9, 1984, in the annual report of Harry Horner and Bruce Wagner to the leaders of the three administrative units who provided the financial support.[6] Bruce had been the supervisor of the facility for seven years when the report was written.

The first major purchase for the facility in connection with Biotech was for a new scanning transmission electron microscope (STEM) in 1989 with a grant from the Kresge Foundation (Chapter Four). Many other upgrades of instrumentation in the facility were made over the years. Of most recent note was the purchase of a new STEM funded in 2006 by a $795,000 grant from the NSF. The proposal for the grant was written by Harry Horner with the assistance of the current manager, Tracey Pepper. With the new instrumentation capability, the name of the facility was changed to its current one in 2006.

Financial support of the facility initially was shared with the College of Liberal Arts and Sciences, including support of staff and maintenance contracts for the instruments. Their support was related primarily to use of personnel and instruments in the facility for teaching courses in the Department of Botany. When they decided to discontinue their support for the maintenance contracts, the choices were to increase the rates charged to users for research or for Biotech to cover what the college had funded up to that time. The Council recommended that Biotech increase its subsidy to the facility instead of increase rates substantially. Fortunately, the college has continued to support part of the salary and benefits of the manager.

The dedication of Harry Horner to the facility deserves special note. He is the only professor-in-charge of a facility who has served continuously during the 25-year history of the biotechnology program. He has spent a great deal of time teaching students to use the instruments, assisting people with their research projects, and seeking ways to upgrade the instruments in the facility. One thing that the Council could always count on during its annual review of the facilities was that Harry would ask for funds for new equipment. We did our best to meet his needs. However, one of his dreams that we were not able to help him realize was a centralized facility on campus for all microscopy services. The best we could do was to help finance, along with other administrative units at ISU, the renovation of the facility's space in Bessey Hall before installation of the new microscope began in 2007.

Hybridoma Facility

The road to the establishment of the current facility was a winding one. It began with a memo to the Council on September 26, 1988, from Vickie Hall, manager of the Cell Facility. In the memo she indicated that her facility was assisting researchers in the production of monoclonal antibodies. She asked for funds to support a half-time assistant to expand the monoclonal activities in the facility. The Council decided to delay action on the request

until a group from ISU could visit the hybridoma facility at UI to determine if they could do the work needed by our researchers. On November 15, 1988, a meeting was held with Rex Montgomery from the regional tissue culture and hybridoma facility at UI. That led to discussions about establishing a satellite of the regional facility at ISU. The Council recommended on January 31, 1989, that we have a satellite facility that would be part of our Cell Facility. On July 11, 1989, the service was formalized under the leadership of Richard Van Deusen, an affiliate professor of plant pathology who had been doing hybridoma work in his department. On July 18, Richard, John Hill from Plant Pathology, and I visited UI to further discuss cooperation between our two institutions. The relevant individuals at the two institutions were satisfied with the cooperative arrangement.

Kristi Harkins was hired in November 1990 to replace Vickie Hall when she left ISU. She gradually assumed responsibility for the hybridoma service from Richard Van Deusen. By 1993, the name of the Cell Facility was changed to the Cell and Hybridoma Facility. Stephen Ford was the professor-in-charge of the Cell Facility when its name was changed. When he left ISU in 2001, Michael Wannemuehler assumed his role.

When Kristi left ISU in April 2000, the hybridoma services were separated from the Cell Facility and Paul Kapke became manager of the Hybridoma Facility. Paul Kapke had been hired in January 1997 to assist Kristi with the hybridoma services.

It is ironic that hybridoma work at ISU was first considered as a satellite activity to a regional facility at UI because our facility has provided services to their researchers since its hybridoma unit closed in December 2006. Our facility is listed in their Web directory of service facilities.

Nuclear Magnetic Resonance Facility

The facility was established with funds from the Kresge Foundation and Biotech that were used to purchase a 500 MHz nuclear magnetic resonance spectrometer (NMR) (Chapter Four). The instrument installed in Gilman Hall became operational on March 1, 1990. Agustin Kintanar from the Department of Biochemistry and Biophysics became the professor-in-charge of the facility, a position he held until he left ISU in 1995. The day-to-day maintenance and administration of the instrument was provided by Robert Scott of the Chemical Instrument Services group managed by Stephen Veysey in the Department of Chemistry. Richard Honzatko from the Department of Biochemistry and Biophysics became the interim manager of the facility until Bruce Fulton began work at ISU on January 10, 1997. Biotech and BBMB have provided part of the salary support for the manager and contributed funds to upgrades of the instruments of the facility.

The facility moved to the basement of the Molecular Biology Building in January 1992. Bruce maintained a close working relationship with Steve Veysey, who also had NMR instrumentation in his facility, Chemical Instrumentation Services. Their cooperation has been of major benefit to the university for providing a range of NMR services without duplication and led to a successful interdepartmental proposal in 2004 for purchasing two new NMR instruments.[7] Grants from NSF, the Roy J. Carver Charitable Trust, and support from many administrative units on campus contributed to the purchase of a 700 MHz

instrument with a cryoprobe and solids capability located next to the original 500 MHz in the basement of the Molecular Biology Building and a 600 MHz instrument with solids and solutions capabilities in Gilman Hall. The instruments became operational in 2006.

Plant Transformation Facility

Support of Biotech for plant transformation began when the Council voted on March 27, 1990, to fund the lease of a biolistic particle system. The instrument was managed by Roger Wise and other faculty members in the Department of Plant Pathology.

The concept of an official Plant Transformation Facility was presented to the Council on April 19, 1994. The facility began operation in the spring of 1996 in the basement of Agronomy Hall in space developed for biotechnology with the $1 million bond funds authorized by the state as part of the $18 million obtained in 1986 (Chapter Two). The facility was established with major funding from the Iowa Soybean Promotion Board, Iowa Corn Promotion Board, Agronomy Department, College of Agriculture, Office of the VPR, and Biotech.

Kan Wang in the Department of Agronomy has been director of the facility since its inception. Maize and soybean were the first crops on which research was conducted. Today, rice and other crops are included in its services. The ongoing support of Biotech has been for part of the salary of the persons responsible for maize and soybean transformation.

The facility has been very effective in securing external funds to research new techniques for plant transformation. The research has led to steady improvement in the effectiveness of their systems, which Kan refers to as their "pipelines." I have enjoyed kidding her about the frequent reference to the pipelines during the annual review of the facility with the Council. Those effective pipelines for maize and soybean have earned the facility a well deserved national and international reputation.

Confocal Microscopy Facility

The proposal for a Confocal Microscopy Facility was brought to the Council by the College of Veterinary Medicine on April 3, 1997. The college indicated that the instrument was critical for the research of their faculty. Faculty members from other colleges also indicated their need for the facility. As evidence of their interest, the college agreed to provide one-third of the necessary funds to purchase an instrument and continuing support for its maintenance. The Council recommended that Biotech provide funds and take responsibility for managing the facility.

A Leica TCS NT confocal microscope equipped with both upright and inverted Leica microscopes was installed in Veterinary Medicine and was operational in April 1998. Margaret Carter, the manager of the Image Analysis Facility, became the manager for this facility, as well. The professor-in-charge since its inception has been Mark Ackermann in the Department of Veterinary Pathology.

The large demand anticipated for the facility did not materialize, and user fees were not sufficient to cover the cost of the maintenance contracts. It became necessary for Biotech and the College of Veterinary Medicine to assist with the maintenance cost. On July 1, 2002, the

College of Veterinary Medicine discontinued its support and Biotech was left with the tab. That experience led me to be even more vigilant in reviewing all requests for support of new instrumentation. Requests that implied "life will end if we do not get the new instrument" or "ISU will not be a first-rate university without the instrument" did not impress me. I wanted to see concrete evidence from the faculty that a new instrument would serve enough faculty and generate enough user fees to cover maintenance costs.

Although the number of hours logged on the instrument was limited, those who did use it were among our most productive faculty. They decided a new instrument with technology not available on the original instrument was needed. After several failed attempts to obtain a federal grant, they were successful in securing a grant from the NIH for $433,000. Although matching funds for the grant were not required, the cost of the instrument with the desired capabilities was estimated to be $725,000. To secure additional funds, a proposal was made to the Roy J. Carver Charitable Trust in Muscatine in May 2008. Concurrently, bids for the new instrument were solicited and received. The Carver Trust approved the request for funds on July 21, 2008, and the Leica confocal microscope was selected by the faculty committee.

There had been a discussion for many years about relocating the Confocal Facility to the main campus near the majority of users. The large cost of renovating space and moving the old instrument prevented any action. With the pending arrival of a new instrument, it was the right time to make the move. The instrument was installed in the basement of the Molecular Biology Building and first used in January 2009.

GeneChip® Facility

The facility was established during 2002 under the leadership of Steven Whitham and Roger Wise of the Department of Plant Pathology. Initial support for the facility was provided by an NSF grant, the Office of the VPR, Agriculture Experiment Station, PSI, and Biotech. On January 2, 2003, Jiqing Peng became the manager of the facility and Steven Whitham the professor-in-charge, positions they hold today. Support for the manager currently is provided by Biotech, PSI, and user fees. The facility originally was located in Bessey Hall. It was moved to the basement of the Molecular Biology Building in October 2003.

W. M. Keck Metabolomics Research Laboratory

The W. M. Keck Metabolomics Research Laboratory was developed with a $1 million grant from the W. M. Keck Foundation to the Center for Designer Crops. The space used for the facility was one of the last undeveloped areas in the basement of the Molecular Biology Building. It was dedicated on June 3, 2004. It provides researchers access to analytical capabilities used to study the molecular processes that determine how organisms grow and develop. The professor-in-charge of the facility since its inception has been Basil Nikolau of the Department of BBMB. The facility's manager has been Ann Perera.

Biotech first provided financial support to the facility July 1, 2007, for part of the salary of the manager. Other units supporting the position are PSI and the Department of BBMB.

The partnerships that have evolved over the years for supporting the university-wide service facilities are illustrated by the request from the facility in April 2009 for Biotech funds to

purchase a new gas chromatography-gas chromatography-mass spectrometer (GC-GC-MS), in addition to what PSI had already approved. The amount requested from our office was more than we had available. I requested and received support from two centers on campus that had faculty who would be using the instrument. The instrument was purchased with funds from PSI, the Office of Biorenewable Programs, the Center for Biorenewable Chemicals, Biotech, and user fees.

Macromolecular X-ray Crystallography Facility
The important role of the faculty in identifying the need for new equipment and services was clearly demonstrated by the establishment of this facility, although the route they took was unusual. Every spring, the Council solicited input on new research services that were needed and dealt with those requests in planning the next year of activities. In this case, I first heard about the new possibility when Vice President for Research John Brighton forwarded an e-mail on April 25, 2007, that he had received from Provost Elizabeth Hoffman regarding a visit she had with Amy Andreotti and Mark Hargrove in the Department of BBMB.

I met with Amy and Mark to understand their request and to implement the normal review process of the Council that included determining the need for the facility and the intended users. I also explored the possibility of one of our existing managers operating the facility, but nobody had the necessary training. Based on the input that was received, the Council recommended support from Biotech for hiring a postdoctoral individual to serve as manager for a three-year trial period. Others providing support for the position included the Department of BBMB, the College of Agriculture and Life Sciences, the College of Liberal Arts and Sciences, and PSI. Julie Hoy in the Department of BBMB was hired for the position with an appointment from October 1, 2007, to September 30, 2010. Richard Honzatko from the same department became the professor-in-charge. The facility has performed very well in meeting the needs of the faculty and students.

Other instrumentation activities
The only service facility that did not make it was for plant hormone research. It was proposed on July 25, 1989, by Clifford LaMotte, a professor in the Department of Botany. The initial support for the facility was approved on November 14, 1989. In April 1994, the Council determined that the limited number of users did not justify continued financial support from Biotech. The facility closed in August 1994.

Biotech has provided support for equipment or other activities to facilities that we do not manage. These have included the Roy J. Carver Laboratory for Ultrahigh Resolution Biological Microscopy, the Chemical Instrumentation Facility, and the Microarray Facility. One of the most unusual requests for instrumentation funds was made by the Department of Animal Science on March 29, 1988. They requested $200,000 for the importation of pigs from the People's Republic of China. The pigs would be the first imported from that country since the end of the Cultural Revolution. They had traits very different from breeds in the US, including unusually large litter sizes. The pigs were considered a valuable tool for animal research by ISU scientists in multiple departments. The request for funds was approved. The Council hoped that some of its investment would be recovered through the breeding and sale of the offspring to other research institutions. That never occurred.

There were a few years when Biotech provided support for instrumentation in addition to that in its facilities. On October 16, 1987, the Council recommended that a competition be established for the purchase of instruments by teams of scientists that would not be part of an instrumentation facility. Nine proposals were received, and all of them were eventually funded. Funding of multi-user equipment continued until 1990 when the four years of lottery support ended. Subsequently, all instrumentation purchases supported by Biotech have been for one of the university-wide facilities.

It has been gratifying to have the excellent cooperation of our personnel in the facilities for providing quality service with the smallest staff possible. Here are just a few examples.

After the Cell and Hybridoma Facility services were separated in 2000, the personnel in the two facilities continued to support each other as needed. This resulted in timely and high quality services for the clients in both units without hiring additional labor.

When Chu-Xiong Liao retired from the Protein Facility in 2008, we discussed with Joel Nott if it would be possible to use staff in other facilities to take his place. The easiest thing for Joel would have been to hire a person with experience in protein research, but that would not have solved our problem of fully utilizing personnel in two other facilities. He agreed to experiment with training Amanda Brockman from the Hybridoma Facility and Margie Carter from the Confocal Facility as Chu's replacement. Likewise, Amanda and Margie were willing to learn new technology with which they had no experience. The experiment has worked very well because of the willingness of everyone to try something new.

The final example of cooperation involves the GeneChip® and the DNA Facilities. To assure that service work would continue in the GeneChip® Facility if Jiqing was on vacation or had to be away from the facility for other reasons, Gary Polking, manager of the DNA Facility, agreed to have one of his staff members trained to run the instruments. The excellent cooperation between Jiqing and Gary has made it possible for the users to have their work done in a timely and high quality manner.

The contribution of the staff to education deserves special note (Chapter Twelve). The extra time the managers and staff spend to provide the workshops in the 542 course, Introduction to Molecular Biology Techniques, while continuing to provide exceptional service to researchers is highly commended.

Chapter Eleven
More Than Science

There was an unexpected twist to the discussion in the legislature during the spring of 1986 regarding state funding for the biotechnology program at Iowa State University (ISU). Two of the legislators, Senator Paul Johnson and Representative David Osterberg, raised questions about the potential social and economic impacts of biotechnology research. They convinced their colleagues to include the following statement in the appropriation bill that authorized funds for the biotechnology program.

> *From the money allocated to the Iowa state university of science and technology for agricultural biotechnology research and development the amount of fifty thousand (50,000) dollars for each of the fiscal years beginning July 1, 1986 and July 1, 1987 shall be used to develop a program in bioethics for research at the university. This program should address socioeconomic and environmental implications of biotechnology research.*[1] [*sic*]

There was general agreement among members of the Biotechnology Council (Council) that examination of the impacts of biotechnology on society should be an important aspect of our new program and that the legislators did us a favor by putting that stipulation in the bill. Even though the bill specified support for two years, the Office of Biotechnology (Biotech) has provided continuous funding for the bioethics program up to the present.

Vice President for Research Daniel Zaffarano decided that he would personally work with faculty in the social sciences to organize a bioethics committee. He thought that asking Biotech to organize the program would be like asking a fox to organize chickens in a hen house. The July 1987 *Iowa State University Biotechnology Update* contained an article that noted the bioethics committee's intent to address the potential effects of biotechnology. It read in part:

> *The ISU Bioethics Committee formed in July 1986 by Vice President for Research Daniel J. Zaffarano will work with scientists to anticipate these effects. Committee members include department representatives from Economics, History, Philosophy, Political Science, Psychology, and Sociology/Anthropology, with additional representation from the ISU Information Service and the President's Office. Fearing the narrowed focus of an internal committee structure, the Committee gathered an advisory group from public and private organizations with bioethics interests. The Iowa Legislature, the state's Department of Agriculture and Land Stewardship, the Center for Rural Affairs in Walthill, Nebraska, and the Minnesota Food Association will participate in the program.*[2]

D. Michael Warren, a professor in the Department of Anthropology and Sociology, was selected by VP Zaffarano to serve as the first chair of the bioethics committee. The co-chairs of the bioethics committee for 1988-1989 were Mike Warren and Steven Gendel, a faculty

member in the Department of Genetics. David Kline also served for a short period of time as chair of the committee until Gary Comstock became the program coordinator for bioethics in 1990. Both David and Gary were in the Department of Philosophy and Religious Studies.

The funds provided to the committee were used for a range of research projects related to bioethics. They also were used to underwrite a newsletter for the bioethics program beginning in 1988 called *The Ag Bioethics Forum*. It included articles written by national leaders in bioethics on a range of agricultural issues. The publication was replaced in October 1991 by *Bioethics in Brief*.

The first national meeting at ISU organized by the bioethics committee was titled the "Iowa State University Agricultural Bioethics Symposium." The symposium, held November 2-4, 1987, exemplified the openness that would be the hallmark of future meetings held at ISU. Speakers representing a range of perspectives on agricultural biotechnology issues participated in the program. The proceedings were published in the book titled *Agricultural Bioethics: Implications of Agricultural Biotechnology.*[3]

The second national meeting was an outgrowth of the participation of the bioethics committee in the review of proposals submitted for the competitive grants program (Chapter Seven). The Council agreed on April 3, 1987, that bioethics representatives would participate in meetings when proposals were reviewed to identify possible issues of concern that could lead to research by faculty in the social sciences. The bioethics committee also provided input on guidelines for the research proposals. On May 17, 1988, members of the bioethics committee met with the Council to review proposals recommended for funding by the external review team. One of the proposals under consideration identified as #A-88-4 had the title "Technology development for the production of transgenic animals at ISU." Members of the bioethics committee met with the Council again on May 24, 1988, to continue discussion of their concerns about the proposal. It was agreed that the Council and the committee would jointly sponsor a symposium dealing with guidelines for transgenic animal research. The workshop took place on October 26-27, 1988, in the ISU Memorial Union. The event was co-sponsored by the ISU Agricultural Bioethics Committee and the Council, with the support of the State of Iowa, the Joyce Foundation, and the Northwest Area Foundation. The proceedings were published as *Proceedings of the Transgenic Animal Research Workshop*.[4]

ISU's involvement in bioethics made it sensitive to public concerns in 1989 when the first field test of genetically engineered poplar trees was proposed by a team of five ISU scientists. With financial support from Biotech, the scientists had used genetic transformation to insert the Proteinase Inhibitor II (PIN-2) gene for the purpose of evaluating the role of the gene on pest resistance. It was to be conducted at the USDA Plant Introduction Station in west Ames. On July 12, 1989, a meeting was held on campus with Ames and county officials at which Carl Carlson from the Iowa Department of Agriculture and Land Stewardship and George Beran of the ISU Committee on Biohazards and Public Health explained the review process by federal, state, and institutional groups. By involving interested parties before the test was planted, the experiment was conducted without any adverse public reaction.

Another conference jointly sponsored by Biotech and the bioethics program was held at ISU on October 29-31, 1990, to discuss the issues associated with the commercial use of herbicide resistant crops developed by genetic engineering. It was a memorable conference because we had a broad range of speakers and participants, including individuals opposed to the concept and members of industry involved in its research and commercialization. To help keep the dialogue civil, I decided it would be helpful for the participants to interact socially away from the meeting site. I invited all interested persons to join me on an evening walk in the woods at the city park called Nutty Woods across from Carr Pool. Many of them participated. It went very well because the moon was bright and the fall air was crisp, which made it impossible for anyone to be serious. The proceedings of the conference, "A Benefit/Risk Assessment for the Introduction of Herbicide Tolerant Crops in Iowa," were published in an expanded edition of the February 1991 issue of the *Iowa State University Biotechnology Update* newsletter.[5]

There was concern in 1987 that the public debate over biotechnology might lead to a reduction in public support for scientific research at land-grant institutions like ISU. As a result, the Boyce Thompson Institute located on the campus of Cornell University at Ithaca, New York, asked ISU to join with their institute, Cornell University, and the University of California-Davis to form a National Agricultural Biotechnology Council (NABC). The request for ISU's participation was sent to President Gordon Eaton who, in turn, asked others and me what we thought of the idea. We agreed that ISU should participate. I was asked to serve as the ISU representative to the NABC.

ISU was the site of the first annual NABC conference on May 22-24, 1989. We chose to examine the relationship between biotechnology and sustainable agriculture. The theme fit ISU well because our faculty were actively involved in both aspects of agricultural research. ISU was an appropriate site for the first conference because we had a well developed bioethics program and welcomed persons with diverse perspectives to participate in the discussion of agricultural issues. Planning for the meeting involved our office, the bioethics committee, and the Leopold Center for Sustainable Agriculture. The conference speakers and conference attendees considered policy issues in four areas: biopesticides, disease control in animals, animal growth promotants, and herbicide resistance in plants. The proceedings of the NABC annual conferences are available from the NABC, 419 Boyce Thompson Institute, Tower Road, Ithaca, NY 14853, phone (607) 254-4856, e-mail nabc@cornell.edu.

I participated in the annual conferences of the NABC and served on its board of directors because Biotech funded ISU's membership in the organization. The annual meetings were organized by member institutions throughout the US and Canada and addressed a variety of topics. One of the reasons for supporting the organization was that it helped to fund the Bioethics Institutes organized by Gary Comstock. We felt that the Institutes helped to provide a forum for discussion of alternative perspectives on issues related to agricultural biotechnology. The support of Biotech for the membership in NABC ended in July 1, 2004, for two reasons. First, Biotech had to absorb a major reduction in funding (Chapter Five). Second, the NABC decided to discontinue support for the Bioethics Institutes. Without their support for bioethics, the benefit of the NABC programs for ISU did not seem enough

to justify the cost of membership. I recommended that we no longer participate in the organization and the Council and Vice Provost for Research James Bloedel concurred.

The first Bioethics Institute organized by Gary Comstock was held at ISU the summer of 1991. The purpose was to teach biological scientists how to integrate discussion of ethical issues in their classes. The 24 faculty members who participated in the first week-long workshop were asked to sign a statement promising to revise their courses to provide additional opportunities for students to discuss ethical issues. It was supported by the Joyce Foundation, the ISU Bioethics Committee, and Biotech. Getting faculty to attend the week-long workshop during the summer was problematic because many of them were on nine-month appointments for the academic year. Biotech was asked to provide an incentive of a $1,500 stipend to each ISU attendee. This led to a debate in the Council as to whether faculty should be paid to receive training. The majority of the Council recommended that the stipend be provided and Vice Provost for Research Patricia Swan concurred.

Gary Comstock was very effective in securing support for Bioethics Institutes that were held at universities other than ISU, including those in the US and foreign countries. The workshops were very well received, except for one requirement that Gary had for any meeting he organized. He insisted that any food served at any bioethics event he organized be vegetarian. Although people were willing to accept a vegetarian menu for a one-day meeting, concerns were expressed when it was a longer event, such as the Bioethics Institutes. The Council debated whether Biotech should support such a practice that offended some faculty in animal-related disciplines. The simple solution for many of us was to offer the participants a choice, but Gary would not accept that concept.

The vegetarian issue came to a head when Gary organized a Bioethics Institute at the University of Wisconsin-Madison on June 1-7, 2002. I attended the event as a participant. I heard grumblings from other participants about the vegetarian meals but did not think much about it because I had heard such comments from colleagues at ISU. A couple of days into the week-long workshop, an animal scientist from a Texas university asked to speak to the participants at the beginning of the day. He said he was leaving the workshop that morning because he was so offended by the lack of respect for him and others in animal agriculture. His decision did not change the menu, but it raised serious concerns about Gary's policy, the same concerns expressed at ISU. The debate at ISU over vegetarian meals eventually ended when Gary left the university.

In August 2001, Kristen Hessler joined ISU to strengthen our outreach program in bioethics (Chapter Twelve). She and Gary Comstock worked cooperatively on the bioethics program for faculty and students until he left to join the faculty of North Carolina State University in 2002.

Clark Wolf replaced Gary as the director of the bioethics program in 2003. He came to ISU from the University of Georgia at Athens where he directed the masters and doctoral programs in philosophy and taught courses in political theory, environmental ethics, and bioethics. Biotech's contribution to his startup package was our first and only one for a non-molecular biologist and consistent with our support of bioethics since 1986.

Clark and Kristen worked together effectively until she left in 2006 to take a tenure-track faculty position at the University at Albany, part of the State University of New York system. Clark has continued to carry out an active bioethics program with support from Biotech and other units at ISU. These activities include a lecture series covering a range of biotechnology-related issues, a bioethics retreat, a variety of course offerings for students, and a bioethics workshop for K-12 teachers and extension personnel.

From my personal perspective, the debate over biotechnology led to speaking invitations I received from outside groups. Some of the most enjoyable were those that also involved David Kline. I was asked to discuss the scientific aspects of biotechnology, and David was to give the bioethics perspective. David had the ability to judge the mood of the audience and to make a presentation that would stimulate debate. If he decided the majority of the audience was supportive of biotechnology, he would delve into potential negative consequences and associated ethical issues. If he felt that the majority of the audience was anti-biotechnology, he would emphasize the positive consequences and provide ethical rationale for the science. One of the hot topics at that time was the use of bovine growth hormone to increase the milk production of dairy cows, a topic that still is debated today. A frequent attendee at the meetings was a Catholic priest from Dubuque, Iowa, Father Norman White. As a strong advocate of family farms, he was a leader of the opposition to the growth hormone. I enjoyed Father White because he always presented his case in a calm manner with a smile on his face. He was a very worthy opponent of the technology.

One of my least enjoyable speaking engagements occurred in the country of Monaco. I was invited to speak to an international organization of seed producers about the US perspective on genetically engineered seed. It seemed appropriate to present the positive aspects of such developments, as well as concerns about them. I practiced my talk to be sure I stayed within the allotted time. The presentation was going smoothly until the moderator interrupted me to say I was over my allotted time and needed to wrap up. I had about five minutes left and hurried to finish. I was embarrassed, frustrated, and puzzled. How could I have gone over my allotted time after practicing it so carefully? As soon as the session ended, I gathered my slides, walked back to the hotel, and gave the talk again. It took less time than I was allotted. I learned from Iowa seed producers at the meeting that the moderator cut me off because he did not want anything said at the meeting about concerns for genetic engineering, particularly in a meeting held in Europe where activists were strongly opposed to the concept.

The bioethics program at ISU has been valuable for raising awareness about the implications of biotechnology research. The support of Biotech for the program is as important today as it was when it began in 1986.

Chapter Twelve
Educating the Next Generation

If the success of the educational programs of the Office of Biotechnology (Biotech) with young people and adults had to be summarized in one word, I would choose AMAZING. Here are just a few statistics that illustrate what the program has meant to the education of young people in Iowa.

- More than 2,100 teachers have been trained to provide hands-on laboratory experiences in biotechnology to their students.

- All of the undergraduate students at ISU who are pursuing teaching careers in biology, agriculture, and family and consumer sciences receive training in the Biotechnology Outreach Education Center (BOEC).

- Free supplies and equipment from the Office of Biotechnology have been used by the teachers for 195,700 Iowa students.

- Through the Web site of the Office of Biotechnology and CDs, persons have access to 26 downloadable lab activities, tutorials, lectures, curriculums, and many other resources.

The history of the educational program could be a book of its own. Only the highlights can be included here.

Undergraduate and graduate education
The first activity for me in biotechnology education was in the role of biotechnology coordinator for the College of Agriculture the last part of 1984. I met with Kenneth Larson, the academic dean for the college, to discuss how we could attract top high school students to biotechnology-related majors. My motivation was influenced by my son Steven who was in his senior year at Ames High School and interested in exploring some field of science during college. Ken and I agreed that one good way to attract students was with scholarships. Together, we developed a Biotechnology Scholarship in Agriculture and went looking for support to offer full-tuition, four-year scholarships to entering freshman in the fall of 1985. By the end of the year, we had raised enough from individuals and from agricultural companies or organizations to offer four-year, full tuition scholarships to outstanding high school seniors.

During the spring of 1985, the first 10 recipients of the scholarships were identified. The criteria for their selection included their ACT scores, academic records, and interest in a field of study related to biotechnology. A celebration luncheon was held during the spring in the Campanile Room of the Memorial Union for the students, their parents, and a teacher from their high schools. One of the scholarship recipients was Lisa Lorenzen, our current director of industry relations and biotechnology liaison at ISU. The biotechnology scholarship program continued to support 10 new students each year while Ken Larson was the academic dean.

The initial discussions by the Biotechnology Council (Council) on the use of funds for biotechnology education centered on development of appropriate courses for undergraduate and graduate students at ISU. With a $400,000 grant in 1984 from the Northwest Area Foundation in St. Paul, Minnesota, the university hired two geneticists. One of the new faculty members, David Morris, began a new graduate lecture and laboratory course titled Genetic Engineering. The laboratory course suffered from a lack of sufficient equipment for the students. To remedy the situation, the Council recommended the expenditure of bond funds to equip the laboratory for the course. That recommendation on June 20, 1986, was the first one made by the Council for support of biotechnology education. Subsequently, the Council recommended funding equipment for teaching laboratories related to biotechnology in other departments.

New undergraduate and graduate courses related to biotechnology were added to the curriculum by many departments over the years, and existing courses were modified to incorporate information on biotechnology. In addition to the courses taught on campus, there was need for a course that could be available to persons in the state and elsewhere who were not traditional students.

A team of faculty members worked together in 1993 to develop an experimental course titled Biotechnology in Agriculture, Food, and Human Health. The course was offered for the first time in the fall of 1993 and had four modules of 0.5 credits each and a science module of 1 credit that included a laboratory. Chris Tuggle from the Department of Animal Science taught the module on animal production. Bonita Glatz from the Department of Food Science and Human Nutrition taught the module on food. Alan Atherly from the Department of Zoology and Genetics taught the module on crop production, and Tom Ingebritsen from the Department of Zoology and Genetics taught the module on human health. The science module and laboratory sessions were taught by David Betsch, who had been hired by Biotech for its biotechnology outreach education program. His laboratory sessions were held at ISU and selected Iowa community colleges.

At the time the course was first offered, off-campus courses were taught by videotaping the lectures on campus and mailing the tapes to the students. Delivery of the biotechnology off-campus course evolved with the development of new electronic technology. Tom Ingebritsen was a critical part of developing and delivering the course to adapt to the new opportunities for delivery. When the Iowa Communications Network (ICN) was developed by the state to improve electronic communication, the course shifted from delivery by tape to direct delivery from ISU to students located at Iowa community colleges. With that system, it was possible to see the students in each classroom and to communicate with them directly. The primary difficulty was finding a time for the class that fit the schedules of each institution to which it was delivered. There was no common schedule among institutions for when classes began and ended. That problem was solved in the fall of 1996 when Tom offered the course for the first time over the Internet. Today, Tom teaches the course over the Internet to students both on- and off-campus.

The course that Biotech initiated and financially supports is Introduction to Molecular Biology Techniques, which is cross-listed under the number 542 by many departments

(Appendix 12.1). The course was designed to provide graduate students the opportunity to become familiar with the techniques and instrumentation available in the service facilities supported by Biotech. The modules are taught by the staff of each of the related service facilities. Financial support from Biotech underwrites the supplies needed for the course so that students do not have to pay a laboratory fee. The course first was offered during spring semester 1996 when it was coordinated by Kristi Harkins, who at that time managed the Cell and Hybridoma Facility, and Gary Polking, the manager of the DNA Facility. Since Kristi's departure, the course has been coordinated by Gary with assistance from managers of other facilities.

As the curriculum in biotechnology-related subjects grew, the need for an undergraduate major in biotechnology was addressed. Such a major would draw on courses in multiple departments. The Council surveyed faculty members and representatives of industry regarding their interest in such a major. One concern from the faculty was that the curriculum requirements of a biotechnology major would not differ appreciably from those in existing majors, such as biochemistry and genetics. Another concern was identifying the appropriate administrative home for the major. The companies surveyed indicated that they cared more about the course work and experience of a student than the major. Given the potential antagonism that could develop between existing majors and a new biotechnology major and the lack of strong interest by industry, the major never materialized. Instead, some departments added the opportunity for students to specialize in biotechnology within a major. In the most recent ISU biotechnology recruitment brochure developed by Glenda Webber of our office, 26 departments or programs described the opportunities for specialization in biotechnology within their majors (Appendix 12.2).

The discussion regarding support of graduate students and postdocs began August 27, 1986, as part of the competitive grants program (Chapter Seven). To bring attention to the competitive grants program and the positions funded by it, an ad was developed for scientific journals that announced the availability of the graduate and postdoctoral opportunities available.[1] The support for postdocs ended in 1989. However, the graduate fellowship program has been continued up to the present. The program was designed to make it possible for ISU to compete financially with any other institution for the best students. For students graduating from a US institution, a graduate program could request support for a one-year stipend for a student, or it could divide the equivalent amount of support among multiple years to be added to its stipend to make the overall offer to the student high enough to be competitive. The eligibility requirements for the fellowships have always been high. The current requirements that must be met include acceptance by the ISU Graduate College, a grade point average of 3.5 or above, a total Graduate Record Exam (GRE) score of 1300 for verbal plus quantitative, and a GRE analytical writing score of 5.0.[2] Other considerations are the quality of the undergraduate and graduate institutions attended; the student's performance in basic science courses; the student's personal statement; letters of recommendation; reasons why the ISU department or interdisciplinary program considers the student to be exceptional; and the student's science background, research experience, and publications related to biotechnology. A total of 209 graduate students have been supported by fellowships up to the present (Appendix 12.3).

One of the challenges for the graduate fellowship program has been how to evaluate students from foreign universities. The application from the department or interdepartmental program included the student's university transcript. The grading procedure for foreign universities commonly was not the letter system used by most US universities. In such cases, the ISU Graduate College provided an estimate of the equivalent grade point average for a US institution. Another challenge in evaluating the foreign students was the quality of the institution, some of which were not familiar to the Council members. Given these limitations, the Council decided to provide half of a one-year stipend for selected students from foreign institutions. The rationale was that the sponsoring department or interdisciplinary program should share the risk of accepting such students.

Review of the applicants for graduate fellowships was done by the Council beginning in 1988 when the first one was received. In 2004, the Council decided that it would prefer that the director of Biotech should review the applicants and only bring to them for discussion those that were questionable. Since that time, I have adhered strictly to the criteria that are established by the Council each fall with regard to GRE scores and GPA.

An important component of biotechnology education on campus has been relevant symposia and conferences organized by the faculty. The first symposium recommended for support by the Council was on October 17, 1986. The symposium dealt with the histocompatability complex. The Council funds are intended to eliminate registration fees for ISU faculty, staff, and students, except for meals and proceedings (Appendix 12.4).

Outreach education

The need to educate the public about biotechnology was recognized at the time planning was done for the first biotechnology workshop held January 14-15, 1985 (Chapter Two). The attendees at the workshop included K-12 teachers and students and members of the general public. That was the beginning of a major effort in outreach education that addressed a broad range of audiences.

One of the key audiences we wanted to address was K-12 teachers. From the beginning, our strategy has been to help teachers learn ways to give their students hands-on experiences and to give them the resources needed to provide those experiences. Our goal was to reach all of the young people of Iowa.

The first meeting to discuss teacher training was held at Drake University in Des Moines on January 9, 1988. Staff of the Cold Spring Harbor Laboratory in Long Island, New York, put on a workshop that I attended, as did representatives from other Iowa institutions. They demonstrated hands-on activities they had developed to help students learn about biotechnology. They indicated that, for a fee, they would be willing to put on teacher training workshops in the state. To me, it did not seem to be a practical long-term solution for teacher training in Iowa. I felt that with the generous support for biotechnology provided by the state, ISU needed to provide leadership in developing for Iowa its own teacher training program. It seemed appropriate to involve other Iowa colleges and universities in the statewide effort.

I approached Lynn Glass, director of the Resource Center for Math and Science in the College of Education, about his interest in working together on a teacher training program. The initial model for teacher training developed with Lynn called for establishment of a Biotechnology Instruction Center at ISU, as explained to the Council on January 22, 1988. The center would be managed by the Office of Biotechnology, with the College of Education responsible for the educational components. Activities of the program would be coordinated with the Resource Center for Math and Science, which was under the Office of the Vice President for Academic Affairs. We would have an advisory board made up of representatives from ISU, the University of Northern Iowa, the University of Iowa, private colleges in Iowa, the State Department of Public Instruction, and representatives from industry.

The organizational meeting of the advisory board for the Iowa Biotechnology Instruction Center met at ISU on March 26, 1988. The meeting was well attended by representatives of educational institutions in Iowa. They expressed interest in teacher training, but they did not have the personnel or finances to put on appropriate workshops. It was an important meeting because we identified people in other institutions whom we could call on for help; however, ISU would need to be the leader for organizing and implementing a biotechnology education program for young people in Iowa.

Our first teacher training workshop was held at ISU during the summer of 1988, thanks to Lynn Glass and his colleagues in the College of Education who had received a grant from the National Science Foundation (NSF) for such a purpose. The workshop was held in laboratories of Bessey Hall. We asked each of the 15 Area Education Agencies (AEAs) in Iowa to nominate the most outstanding science teachers in their region. One of the attendees was Mike Zeller, a science teacher at Woodward-Granger High School. He became an instructor at future teacher workshops and eventually was hired in 2000 as the first full-time biotechnology outreach education coordinator for Biotech. For the 1988 program, we had presentations by some of our molecular biology faculty and ISU Extension personnel who were familiar with genetically engineered products. We also spent time in the laboratory conducting hands-on experiments. We learned from the presentations that extension personnel were very good at communicating with the teachers. Some of the faculty gave presentations that were more appropriate for a scientific meeting, which meant they were too complex for teachers who were just beginning to learn the science of biotechnology. We learned from that experience to be selective in the faculty members we used for our teacher workshops.

After the initial workshop, we looked for ways to organize and conduct additional activities. On April 25, 1989, the Council was told that David Betsch would be coming to Ames to establish a business that offered training programs in molecular biology. David had a PhD in molecular biology from Purdue University and had established the company Biotechnology Training Programs, Inc. His programs were primarily for industry scientists whose companies wanted their employees to learn the latest in molecular biology techniques. Fortunately for us, David also had an interest in educating teachers and lay persons. The Council discussed on October 24, 1989, a possible relationship with David for conducting education programs. In addition to his work with industry, he wanted to set up training programs for faculty and

postdocs in advanced molecular techniques and contribute to our teacher training program. Biotech was asked to underwrite the program and evaluate and monitor its quality.

An alternative strategy for implementing a biotechnology outreach education program was proposed to the Council on November 7, 1989. It called for the creation of a 1/3 time position in the university's professional and scientific employment category to conduct the outreach program. A search committee was formed at the meeting and three candidates were interviewed early in 1990. None of the candidates were considered acceptable. As a result, we engaged David Betsch to conduct teacher workshops for us beginning in 1990.

David had a unique resource for conducting teacher workshops outside of Ames. He had equipped a large motor home with all of the instruments and supplies that were needed. I recall visiting a workshop he was conducting at the North Iowa Area Community College in Mason City, Iowa. He had driven his motor home into a large room and set up tables where the teachers practiced biotechnology experiments that they would, in turn, offer to their students. Whatever they needed was just a few steps away in the motor home. David was very well received by the teachers and did excellent work for our program.

In addition to his workshops for teachers, David worked with Glenda Webber to begin the development of a Biotechnology Information Series for use with a range of audiences. Glenda wrote and/or edited a total of 11 publications in the series in cooperation with specialists in each area (Appendix 12.5).

In August 1991, the administration at ISU agreed to establish a public education fund for biotechnology in the ISU Development Foundation. The program was supported initially by the Iowa Farm Bureau Agricultural Leadership and Promotion Foundation; Iowa Soybean Promotion Board; Monsanto Company; Penford Products Company; Pioneer Hi-Bred International, Inc; Pitman-Moore Company; and West Central Cooperative. Over the years, additional companies, organizations, and individuals have provided financial support for the program.

In January 1992, ISU Extension and the Office of Biotechnology launched a five-year educational program in biotechnology. The original plan was to cooperate with the University of Missouri – Columbia and the University of Nebraska – Lincoln on the project. Despite those good intentions for a cooperative effort, the education programs in each state largely were implemented independently.

The active program in biotechnology outreach education and the successful relationship between ISU Extension and Biotech has never stopped. Fortunately, the history of the program has been well documented since January 20, 1992, when the first issue of the *Update on the Public Education Program in Biotechnology at Iowa State University* was published. The name was changed to the *Iowa Biotech Educator* beginning with the June 30, 1994, issue. Glenda Webber is the current editor of the publication that is sent to more than 1,700 individuals and schools.

To encourage participation of Iowa community colleges in the five-year plan, my wife, Elinor, and I decided to visit each of them and discuss face-to-face how we might work together. There was some suspicion about the motive for our visit. It was common for the college representatives to begin the discussion by asking what ISU wanted from them. Despite a rough start at times, we ended on good terms, as evidenced by the number of community colleges that hosted workshops in 1992. They included Kirkwood Community College in Cedar Rapids, North Iowa Area Community College in Mason City, Ellsworth Community College in Iowa Falls, Southwestern Community College in Creston, Iowa Western Community College in Council Bluffs, Iowa Central Community College in Fort Dodge, Iowa Lakes Community College in Emmetsburg, Western Iowa Tech in Sioux City, Muscatine Community College in Muscatine, Northwest Iowa Technical College in Sheldon, Hawkeye Institute of Technology in Waterloo, and Northeast Iowa Community College in Calmar.

There was a specific target audience for each workshop. Those workshops with targeted audiences in 1992 included events for ISU students, veterinary medicine students and professionals, and farmers in January; for agribusiness in March, August, September, and December; for agronomists, agricultural chemical dealers, and farmers in March; for health professionals in April and August; for science and agriculture instructors in June, August, and October; for extension personnel in June and August; for agriculture, science, health, and home economics instructors in June; for veterinarians and science and agriculture instructors in June; for purebred livestock producers, veterinarians, agri-business, extension staff, and community college staff in August; for the food industry, extension staff, science and agriculture instructors in August; for agribusiness and science and agriculture instructors in August; for secondary and post-secondary teachers in September; for community college instructors in August and October; for agribusiness and extension staff in November; and for extension specialists and science and agriculture instructors in December.

David Betsch and Tom Ingebritsen taught the science of biotechnology and oversaw the associated hands-on activities for the workshops. Extension staff, ISU faculty members, and members of industry also played an important role in the programs.

An information sheet distributed about the workshops read:

> *<u>What would I learn?</u>*
> *The workshops are tailored to the needs of the audience and typically include explanations of the science behind new products, their applications, and discussions of the regulatory and ethical issues associated with biotechnology, as well as laboratory experience.*[3]

Participants in the workshops were able to earn continuing education credits from ISU Extension, staff development credits through the AEAs, or undergraduate or graduate credit through ISU.

The work of ISU Extension personnel in 1992 extended beyond the workshops. The extension staff involved with youth programs decided biotechnology would be a good theme for summer youth camps. During that summer, they had three- or four-day camps at the

North Iowa Area Community College at Mason City, the Iowa 4-H Education and Natural Resources Center near Madrid, and the Pine Bluff 4-H Camp near Decorah. The Iowa Soybean Association sponsored the camp and assisted with the publicity. Tom Ingebritsen, along with the extension staff, conducted the programs.

One of the most popular activities at the camps involved solving a crime using DNA fingerprinting. One of the staff was the crime victim. A law enforcement officer came to the camp to teach the young people how to collect evidence, including samples of hair left by the culprit. Tom used the hair samples to teach them how to extract DNA, make copies of it, and run an electrophoresis gel. They worked with pipettors and other laboratory equipment. After the DNA evidence was ready, the campers worked with an attorney to prepare the case, and a trial was held with the parents of the students as the jury. This successful activity led to the curriculum *A Crime, A Clue and Biotechnology* (Appendix 12.6).

With all of the interest among teachers for integrating biotechnology into their classes, the challenge was to find enough individuals willing to provide teacher training workshops throughout the state and assist the teachers when they had questions about the various laboratory activities. That challenge was addressed at a meeting at ISU during October 1992. The report of the meeting read:

> *High school science and agriculture teachers who have been actively integrating biotechnology into their curricula met in October at Iowa State University. They shared their concerns about the need for more instruction on the use of equipment to demonstrate the science of biotechnology and on ways to fit biotechnology activities into existing curricula.*
>
> *According to Robert Martin, ISU Professor in Agriculture Education and Studies who chaired the meeting, "The group decided to prepare in-service activities to serve as a model for the high school laboratory in agriculture and science. The group will continue to meet to plan workshops for the teacher-teach-teacher model. We look forward to conducting workshops during the school year." More information on these workshops will be in future UPDATES.*[4]

The teacher-teach-teacher model discussed at that meeting led to the formation of a group known as Master Teachers in Biotechnology. A description of this special group of people as described in the August 30, 1993, issue of the *Update on the Public Education Program in Biotechnology at Iowa State University* read:

> *Fifteen biology teachers, each representing an Iowa area education association, have accepted an important mission to assist other middle and high school teachers in conducting hands-on biotechnology laboratories.*
>
> *These teachers were selected by science consultants from their Iowa Area Education Agencies. The teachers advised the Public Ed Program on the needs of other teachers as they implement the science in their classrooms.*

Each lead teacher will put on an in-service for other biology teachers in their area of the state. The in-service will include activities and laboratories teachers will be readily able to implement in their classrooms. Each school represented at an in-service will receive a kit complete with equipment and supplies to conduct DNA extraction and transformation laboratories. The teachers will be given extensive training on how to prepare and conduct the laboratories for their students. The AEA science consultant will have equipment, courtesy of Iowa State University, to loan area teachers for DNA fingerprinting laboratories.

. . . .

These in-service workshops are possible due to a grant to the ISU Public Education Program in Biotechnology at ISU from the Roy J. Carver Charitable Trust. The Trust was established under the will of Roy J. Carver, an Iowa industrialist and philanthropist, to help youth through educational opportunities and to help build a better world through medical and scientific research.

The teachers participating in this program are

Rod DeVries, Forest City High School
Diane Den Herder, Sioux Center High School
Gene Ficken, Independence Community High School
Dave Millis, Edgewood-Colesburg High School
Morris Green, Emmetsburg High School
Dan Boelts, Iowa Falls High School
Cindy Reher, Humboldt Senior High
Gary Garton, City High School, Iowa City
Mike Zeller, Woodward-Granger High School
Ron Wilmot, Akron-Westfield Community Schools
Dan Huey, Atlantic Schools
Don Holland, Tri-County Schools, Keswick
Ernest Schiller, Central Lee High School
Marge Welch, Lenox Community School
Brian Cummings, Columbus Community High School[5]

The number of master teachers increased at times to meet the demand for their assistance in workshops and for mentoring their colleagues. All of their work was voluntary, which was a tribute to their commitment to education. We held special workshops for them as a group to thank them for their service, to promote the exchange of ideas among them, to evaluate new activities and curriculum under development, and to learn firsthand from specialists in various fields related to biotechnology. An example of those workshops was one held during the summer at the University of Iowa where we studied the application of biotechnology to human medicine with an emphasis on human genetics. We stayed in the Mayflower dormitory and relived life as a student. The accommodations were nice, but none of us indicated a desire to trade our home for dormitory life. The presentations made by the faculty and staff working on human genetics were extremely interesting, particularly those that dealt with genetic counseling. They helped us understand the emotional challenges

faced by individuals who had to deal with genetic conditions unfavorable to their health or that of family and friends. That workshop put a human face on biotechnology.

The master teacher program continues to be a very important part of the outreach education program. In the September 2008 issue of the *Iowa Biotech Educator*, 11 master teachers were listed. In addition to their service, extension personnel working with youth continue to play an important role in biotechnology education.

A grant from the Roy J. Carver Charitable Trust in 1993 was the beginning of our effort to provide at no cost to teachers in every Iowa school the curriculum, supplies, and equipment needed for conducting hands-on activities with their students. With the grant and the support from other organizations and companies, every school district in Iowa was given a Styrofoam kit full of essential equipment and supplies (Appendix 12.7). With those items and things they had in their home or could purchase at a local store, the teachers could do DNA extraction from fruits or vegetables and bacterial transformation, two of the popular lab activities at that time. Lori Miller in Biotech took the lead in assembling and distributing the kits. I call Lori the best known secretary at ISU because she is the person whom teachers contact to order equipment and supplies, register for workshops, arrange visits of their students to campus, and many other educational activities. She described the kit preparation and distribution effort as follows:

> *I began the project by working with the 15 AEAs to determine how many kits were needed. The total we had to make in order to have one for each school in Iowa was 400. The next step was to find the least expensive source of the various supplies for the kits. We purchased the majority of the kit supplies from WalMart or Cub Foods to make our initial kit. We then contacted the manufacturers of the larger items directly to place bulk orders to get the best price. For example, the Styrofoam container served as a place to store the supplies and as an incubator for the bacterial transformation experiment. These were purchased from Berry Packaging, Inc. The hot plates, which were used to heat water for sterilization, were from Toastmaster, Inc. The supplies were delivered to the Molecular Biology Building. Peter Lelonek, the building manager, gave us space in a storeroom in the basement in which to store and assemble the kits.*
>
> *I think everyone in the office helped at one time or another to count different items that were included in each kit. We also hired several extra workers to help count and measure things. For example, we counted 72 glass test tubes, put the lids on them, inserted them into test tube racks, and put 32 stirring rods, 64 pasteur pipettes, and 40 microcentrifuge tubes in baggies. One of the most dreaded activities by me and the workers was measuring 70 g of LB (luria broth) premix used for bacterial transformation into a 4 oz plastic bottle. Even under a hood, you got LB dust all over. Each kit had to be packed a specific way or everything did not fit. I was a pro at it by the end of the summer.*
>
> *We distributed the kits in several ways. The teachers that attended a workshop during the summer of 1994 were sent home with a kit for their school. At the end of*

the summer, kits that still needed to be delivered to schools were taken to the AEAs for distribution. I drove a van to several different AEAs that summer to deliver the kits.[6]

It was too expensive to give each school the equipment and supplies for DNA fingerprinting. Instead, a kit with the necessary equipment was given to each of the AEAs (Appendix 12.8). When a teacher wanted to do DNA fingerprinting, the kit was taken to them by the AEA and the teacher ordered the necessary supplies from Lori. When the teacher was done with it, the AEA picked up the kit and took it to other interested teachers. As demand for the kit grew over the years, each ISU Extension area office in the state was given a kit that teachers could access, as well.

The equipment and supplies program of Biotech evolved over time as new curriculums and activities were developed (Appendix 12.9). The first four curriculums were written by extension personnel for use in 4-H programs and in schools for classes up to grade 8. The target audiences for the four curriculums developed by Biotech were middle and high school students (Appendix 12.6). They focused on the application of biotechnology to agricultural products, an area that other groups had not addressed in developing resource material for educators. Biotech's four curriculum projects were a team effort involving people at ISU and elsewhere. The person who deserves much of the credit for all of them is Glenda Webber. She had taught various combinations of language arts, speech, and Spanish to students in grades 5-12 for nine years before joining the Office of Biotechnology. This experience was invaluable for understanding how to translate scientific information into curriculums that teachers and their students could use effectively. Her exceptional editing skills were responsible for the high quality of each curriculum.

When David Betsch left Ames about 1995, there was a need for someone to assist with the teacher training program. Up to that time, my involvement was primarily with adult audiences who wanted to spend an hour or so learning about biotechnology. I especially enjoyed participating in those programs for adult audiences because I got the opportunity to make presentations with my wife, Elinor. To engage the audience, we would set up a table at the front of the room at which we would provide a demonstration on how genetically engineered chymosin was used in cheese production. We added a few drops of the enzyme to a measuring cup with some whole milk and put the container in water in a cake pan that was heated to the right temperature by a hot plate. Next, Elinor would carry out DNA extraction from onion with common household products, including dishwashing detergent and salt. While she was carrying out her activities, I would discuss the science of biotechnology and the attributes of current and future genetically engineered products. When her work was done, we invited a member of the audience to come forward and turn the container of milk upside down to show the effect of the chymosin on solidifying the milk components as a key step in some cheese manufacturing. That led to a discussion of any concerns the audience would have about eating cheese made with the genetically engineered chymosin. Not everyone was pleased about that possibility.

The onion extract was poured into test tubes that were handed out to the audience, along with a cold test tube of alcohol and a glass rod. They were asked to pour the alcohol and

extract together and watch the DNA come out of solution. When everything went well, they could pull the DNA out of the solution with the glass rod that had a hook on the end. When asked what it looked like, some of the farmers in the audience said it looked like hog snot, a true Iowa agricultural response. That part of the demonstration was used to help the audience understand that we eat DNA every day in our food. It was an important lesson because some people thought DNA was present only in foods that were genetically engineered.

There were times when the audience was so large that we did the DNA extraction in our kitchen and prepared the tubes of extract. Someone in Biotech generally prepared the test tubes of alcohol for us, which we kept in a cooler of ice until needed. In those cases, the demonstration was done as usual, but we did not take time to prepare tubes with what we had prepared. One such event took place at what was then the Best Western Inn east of Ames on 13th Street. We were told to expect about 75 people. When we got there, the audience was more than 200. We hurried to an adjacent room and used the extra onion we had brought to prepare more extract before it was our turn on the program.

Traveling in Iowa during the winter, especially in the evening, was not on my list of most enjoyable activities. Coming home one night from a speaking engagement on biotechnology, we hit some black ice on a curve and slid into a ditch near Grand Junction west of Ames. The ditch was full of snow so the car looked like it was sitting on a pillow. We walked about a half mile to a convenience store and called for a tow truck. We did not realize that such a call automatically resulted in contact with the sheriff who would investigate what happened. Sitting in the back of the patrol car, we could tell that our sobriety was being thoroughly considered, although a breathalyzer was not used. By the time the tow truck came, there also was a highway patrolman on the scene. Fortunately, the car was not damaged and we did not have to financially support law enforcement programs or spend time in jail.

On the positive side of travel, we were invited to some interesting places, including a demonstration of our educational activities with our ISU extension colleagues at the National Science and Technology Symposium in Orlando, Florida, during January 1998. The trunk of our car was packed with equipment and supplies we ordinarily would not take to Florida. It was a very good experience because the organizers had arranged for us to spend a day backstage at Sea World and the Epcot Center to learn about their educational activities.

The programs with adult audiences did not prepare me to conduct a teacher workshop. The master teachers knew more about how to carry out the other hands-on activities than I did. I thought a lot about whether I was willing to suffer the embarrassment of learning the procedures myself, including making and running an electrophoresis gel and doing a bacterial transformation. There was little choice, so Tom Ingebritsen let me work in his laboratory. It happened just as I feared. "You don't know how to do that?" was a common comment of his staff. Embarrassed or not, I had to learn.

Practice sessions on how to successfully do bacterial transformations took place in the basement of my home with one of the kits provided to the schools, plus what a teacher could get locally or order from Biotech. One of the things I learned was that the instructions for the

experiments needed to be simplified and illustrated. Elinor and I had written and illustrated instruction manuals for lay audiences related to my soybean research. With her help, I rewrote the instructions for bacterial transformation and other experiments, which helped me to learn how to teach the procedures to others.

For teaching DNA fingerprinting, I liked the idea used in the ISU Extension youth camps of solving a crime with DNA fingerprinting, but I did not want to relate it to the death of someone. So I made up a story about a family that had four dogs. One day the family found that a boot had been chewed up by one of the dogs and they wanted to find out which dog had done it. They collected hair samples left on the boot and from each of the dogs. The students were responsible for doing the DNA fingerprinting necessary to find the culprit. With the help of Tom Ingebritsen and others, we selected the least expensive restriction enzymes and DNA we could buy to send to teachers so their students could run a gel and figure out who chewed up the boot. That story and activity continues to be popular today.

Our group at ISU was always interested in learning about educational materials and teaching strategies developed by other institutions. To this end, we organized a national symposium titled "Extension's Role in Biotechnology Education" that was held at Iowa State University on October 20-23, 1996. Nearly 200 Extension professionals, schoolteachers, and other biotechnology educators from the US, Canada, and Venezuela attended the conference. Another national symposium was held at ISU on October 8-10, 2000, titled "Engaged Institutions' Role in Biotechnology Education." More than 225 educators from 30 states, Canada, and Brazil attended the symposium.

Biotechnology Outreach Education Center

One of the limitations we faced for hosting educational activities on campus was finding a classroom we could use, particularly when university classes were in session. We needed a laboratory dedicated to our outreach education program. In 1997, I decided it was time to make such a facility a reality. There were two major challenges: finding space for the laboratory and raising the funds necessary to build and equip it.

The Molecular Biology Building was designed to include unfinished spaces that could be developed as the need arose. The space I requested from Vice Provost for Research Patricia Swan for what became known as the Biotechnology Outreach Education Center (BOEC) was in the basement of the building. A request for that space also had been made by two faculty members, Philip Haydon of the Department of Zoology and Genetics and Marc Porter of the Department of Chemistry. They were raising funds for what became known as the Roy J. Carver Laboratory for Ultrahigh Resolution Biological Microscopy. The competition for the space in the basement led to meetings in Beardshear Hall with VP Swan, Ellen Rasmussen of Provost John Kozak's staff, and others. As a result of the discussions, Peter Lelonek, the building manager, was asked to provide information on additional unfinished spaces that could be considered. One space was on the main floor that was originally intended for the installation of extra large growth chambers that could be used to grow corn to maturity. The need for that space had not materialized. When the smoke cleared, we were given that space for the BOEC.

The estimate for finishing and equipping the space was $500,000. In cooperation with the ISU Foundation, we mounted a major fund-raising effort. We were able to raise $195,000 from companies, organizations, and individuals. Those who contributed $25,000 or more are listed on a plaque hanging outside the BOEC. VP Swan agreed to use interest from endowments of the Office of Biotechnology to cover the rest of the costs.

Now that we were finally going to have our own facility for the outreach effort, it was time to hire our first full-time person to develop and deliver the educational programs. It was our good fortune to have as an applicant for the position Mike Zeller, a science teacher at Woodward-Granger High School, who had attended our first teacher training program in 1988, had served as a master teacher, and was an instructor at our teacher workshops at ISU during the summer. He became our biotechnology outreach education coordinator in January 2000. The BOEC was dedicated on April 14, 2000.

The next major addition to the outreach education program was the hiring of a bioethicist, Kristen Hessler, in August 2001. Although we had tried to include bioethics in our outreach programs, the only ISU bioethicist available to assist us was Gary Comstock in the Department of Philosophy and Religious Studies. The amount of time he had available for our program was limited because of his many other professional activities. With support from a United States Department of Agriculture (USDA) grant that will be discussed later in this chapter, we had the opportunity to experiment with hiring someone who could provide a more extensive emphasis on bioethics.

That person was Kristen Hessler. She was hired in 2001 as a bioethics fellow, instead of as a traditional staff person or faculty member, because we were not certain if the experiment would work. She divided her time between the Department of Philosophy and Religious Studies and the Office of Biotechnology. Her work in the department included teaching an undergraduate course and conducting research in bioethics. For our program, she was called the bioethics outreach education coordinator.

As a participant in the USDA-funded project, she worked on unique educational initiatives that reached beyond Iowa. One of her novel initiatives was the development and delivery of Iowa's first online course in bioethics. The course was first delivered in January 2002 as An Introduction to Biotechnology Ethics.[7] She expanded the course in 2004 to include modules on Teaching Bioethics and on Ethics and Biotechnology.[8] She added another module in 2005 on Ethics and Animals.[9] The courses were taken by persons in multiple states.

A second initiative of Kristen's was the first bioethics workshop for K-12 educators and extension personnel. We had included bioethics as part of our teacher workshops whenever possible, but we did not have one dedicated solely to bioethics. Her first workshop was held in June 2003. Kristen was an excellent teacher and the workshop was very well received by the participants.

A third contribution of Kristen's was the first extension bulletin that addressed how to use bioethics to analyze the merits of products and processes developed by biotechnology. *About Ethics* was published in March 2005. The principles presented in that bulletin also were

incorporated as modules in the curriculums on *Bacillus thuringiensis: Sharing Its Natural Talent with Crops* and *From Mendel to Markers: Impact of Molecular Technologies on Animal, Plant, and Human Genetics*.

Kristen's outreach activities continued until 2006 when she left ISU to become a tenure-track faculty member at the University at Albany, part of the State University of New York system. When she left, the financial status of Biotech had changed substantially in two ways from when she was first hired. First, the USDA grant had ended and there was no opportunity to renew it. Second, state funds to Biotech had been drastically reduced beginning July 1, 2003. The reduction in state funds made it necessary to make major changes in the overall biotechnology program, which included eliminating her position. It was a significant loss to our outreach program.

USDA Grant

The USDA grant referred to above was a rare opportunity for funding the outreach education program. In 2000, the USDA issued a call for proposals for its Initiative for Future Agriculture and Food Systems. I refer to it as rare because all of the requests for proposals from the USDA involving biotechnology with which I was familiar did not offer support for outreach education programs or for research related to social and economic aspects of agricultural biotechnology. Considering the extensive activities at ISU in outreach education and bioethics, the opportunity was too good to pass up.

I knew that to be successful, we had to involve other institutions. My first calls were to institutions that had worked with us in the National Agricultural Biotechnology Council (NABC), including the University of Missouri–Columbia, Purdue University, and the University of California–Davis. They had already decided with whom they were going to align, and ISU was not included. Those groups would be our major competitors for the USDA funds.

To be an effective competitor, I decided we needed to involve institutions that had a special status with the USDA. These included institutions in states that had received less federal grant funds than institutions like ISU and colleges operated by Native American groups. Our office did the majority of the work to prepare the grant, but South Dakota State University was listed as the organization to which the award should be made because they had the special status. When the 292-plus page document was mailed, there were nine institutions that had agreed to participate. A paragraph in the introduction of the proposal read:

> *Each of the land-grant institutions bring unique capabilities to the consortium. The tribal colleges, Cankdeska Cikana Community College, Lac Courte Oreilles Ojibwa Community College, Leech Lake Tribal College, and Si Tanka Tribal College provide an opportunity to explore the cultural perspectives of American Indians in collaboration with South Dakota State University (SDSU). North Dakota State University (NDSU) is in a unique position to explore how the adoption of genetically engineered crops could impact the competition with foreign producers of wheat, canola, and other northern crops. The University of Minnesota-St. Paul (UM) is located in a major metropolitan area where consumer perspectives can be*

compared with those encountered in the rural areas of the region. The University of Wisconsin-Madison (UW) has extensive experience with the introduction of bovine somatotropin that will be invaluable for understanding the impact of a genetically engineered product on the structure of agriculture, labeling, and consumer acceptance. Iowa State University (ISU) has internationally recognized programs in agricultural bioethics and in biotechnology outreach education that will serve as models for initiating similar activities in other institutions of the region. The consortium will conduct research, extension, and education activities that are fully integrated across subject areas and institutions.

The nine land-grant institutions represent a unique partnership that will actively engage their communities in the design, implementation, and evaluation of the grant activities. Stakeholders who will participate in the proposal include the Iowa Biotechnology Association; the Iowa Department of Agriculture and Land Stewardship; the Iowa Pork Producers Association; the Iowa Soybean Association; the Minnesota Department of Agriculture; the Minnesota Institute for Sustainable Agriculture; the Minnesota Soybean Growers Association; the Minnesota Soybean Research and Promotion Council; the National Sunflower Association; the North Dakota Department of Agriculture; the North Dakota Wheat Commission; the Red River Valley Potato Growers Association; the Red River Valley Sugarbeet Growers Association; the South Dakota Crop Improvement Association; the South Dakota Oilseeds Council; South Dakota Wheat, Inc.; and the Wisconsin Department of Agriculture, Trade, and Consumer Protection.

The consortium is well aware of the important global implications of the research, extension, and education efforts in this proposal and has solicited insight and support from four collaborators in key regions of the world: Krista Broten, information specialist, Ag-West Biotech, Saskatoon, Canada; Robert Lindner, economist, University of Western Australia, Nedlands; Dean Madden, information, curriculum, and training specialist, National Centre for Biotechnology Education, University of Reading, United Kingdom; and Humberto Rosa, ethicist, University of Lisbon, Portugal.[10]

After months of work by the staff of Biotech, the document was ready to mail. We took it to the mail office of the university with specific instructions about the mailing for that day. Not leaving anything to chance, I checked later in the afternoon to be sure it had been sent. To my horror, I found that someone in the mail office had decided to delay sending it. If that had happened, the proposal would not have arrived by the deadline and the months of work preparing it would have been in vain. Needless to say, the proposal was sent immediately. The party we held after the proposal was on its way was followed by another party when the four-year project was funded.

The project gave me the opportunity to visit and learn more about the eight other institutions with whom we had partnered and many of the stakeholder organizations. On one summer trip, the route Elinor and I took was to South Dakota's Department of Agriculture in Pierre; Si Tanka Tribal College in Eagle Butte; the National Sunflower Association and National

Wheat Commission in Bismarck and Candeska Cikana Community College in Fort Totten, North Dakota; and the Red River Valley Potato Growers Association in East Grand Forks, Minnesota. We visited the Lac Courte Oreilles Ojibwa Community College in Hayward, Wisconsin, and Leech Lake Tribal College at Cass Lake, Minnesota, on another trip.

The interaction with the tribal colleges was a valuable personal experience. Michael Wassegijig Price, an instructor at Leech Lake Tribal College, was very effective in describing his perspective on biotechnology and its relationship to the native American culture. His perspective was so interesting that I invited him to ISU to give a lecture on the subject. He explained that in the teaching of biology at his institution, they respected their traditions while conducting laboratory activities. When they collected samples to bring to class, they first had a ceremony to thank nature for providing what they needed. When they were done with the collected samples, they tried to return them in the best condition possible to the place from which they had been taken.

Michael described the role of various living creatures in a unique way. He said that humans were the least important because they could not live without the food provided by animals and plants. Animals were more important than humans because they did not need humans to survive. Plants were the most important because they did not need either humans or animals for their existence.

A visit to Lac Courte Oreilles Ojibwa Community College was special because we were invited to participate in a tribal ceremony to dedicate a new drum for the school that had been made by their elders. An elder conducted the ceremony in his native language. He spoke to the four cardinal directions, North, East, South, and West. We smoked a pipe that was passed among persons in the large circle and waved the smoke over ourselves. The meaning of those ceremonial activities can be found on the Internet. We were grateful that they let us be a part of their dedication.

During the grant, ISU took the lead in organizing several meetings. One example was an event held to address the conflict between organic crop production and production of genetically engineered crops. The meeting was held November 27-28, 2001, at the Embassy Suites in Minneapolis, Minnesota, because that location was centrally located for the participating states. We had speakers representing various perspectives and divided the attendees into subgroups to discuss possible solutions to the conflict. The recommendations that were developed at the meeting were part of the ensuing discussions on the topic by various state groups[11]. The topic remains under discussion today.

The funds provided to ISU were important for our program, so I was hopeful that the USDA would continue to have a request for proposals on the same subject when our grant ended. However, there were no requests for proposals during the last year of our grant. I went to Washington, D.C., to meet with program managers of the USDA, National Science Foundation, and National Institutes of Health to find out what opportunities there might be to continue at least some aspects of our project. I visited with a staff member of Senator Tom Harkin to find out if there was any chance the Congress might direct funds to the federal

agencies for a program like ours. Everyone was sympathetic to our cause, but no funding opportunities were available by the end of the grant.

As this history ends on June 30, 2009, the outreach education program at ISU is viewed as one of the best in the nation. It is my hope that 25 years from now it will be as vibrant and effective as it is today.

Notes

All sources cited are stored in the Iowa State University Archives maintained by the Special Collections Department, 403 Parks Library, Iowa State University, Ames, Iowa 50011, phone (515) 294-6672, e-mail archives@iastate.edu. As much as possible, correspondence citations retain the exact names/titles that appear in the originals.

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In the Beginning

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The Breakthrough

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[2]Letter from D. J. Zaffarano, Vice President for Research and Dean of the Graduate College, Iowa State University, to Biotechnology Council, Iowa State University, April 9, 1986.

[3]Minutes of the Biotechnology Council, Iowa State University, meeting held January 9, 1987.

[4]Letter from Claire Hueholt, Editor-in-Chief, *Iowa State Daily*, to Professor Walter R. Fehr, Chair, Biotechnology Council, Iowa State University, September 3, 1987.

[5]Letter from Walter R. Fehr, Biotechnology Coordinator, Iowa State University, to Claire Hueholt, Editor-in-Chief, *Iowa State Daily*, November 20, 1987.

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[7]Confidential letter from Ted Okiishi, Wolfgang Kliemann, David Oliver, Don Reynolds, and Wendy Wintersteen, Iowa State University, to Benjamin J. Allen, Vice President for Academic Affairs and Provost, Iowa State University, August 19, 2005. Not included in the Archives.

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[1]Letter from Walter Fehr to Vice Provost Patricia Swan, Iowa State University, December 19, 1989.

[2]E-mail message from John Pesek to Walter R. Fehr, Iowa State University, April 15, 2005.

[3]Letter from Benjamin J. Allen, Vice President for Academic Affairs and Provost, Iowa State University, to Catherine E. Woteki, Dean, College of Agriculture, and Stanley R. Johnson, Vice Provost, University Extension, Iowa State University, July 8, 2003.

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[2]"Controversial New Art Work Is Forum Topic," *The Daily Tribune*, February 29, 1992.

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[2]Letter from William H. Kelly, Dean, College of Sciences and Humanities, Iowa State University, to Walter Fehr, Biotechnology Council, March 30, 1987.

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State-of-the-Art

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[2]"Center of Excellence in Agricultural Biotechnology at Iowa State University, Background Information Requested by the Honorable Governor Terry E. Branstad," prepared by the Biotechnology Council, Iowa State University, 1985.

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[2]"Bioethics and Biotechnology – A Surprising Partnership at ISU," *Iowa State University Biotechnology Update*, July 1987.

[3] *Agricultural Bioethics: Implications of Agricultural Biotechnology*, Steven M. Gendel, A. David Kline, D. Michael Warren and Faye Yates, editors, Iowa State Press, 1990.

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[5]"A Benefit/Risk Asessment for the Introduction of Herbicide Tolerant Crops in Iowa," *Iowa State University Biotechnology Update*, Vol. V, Issue 1, February 1991.

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Educating the Next Generation

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[3]"Biotechnology Public Education – Iowa State University, University of Missouri, University of Nebraska," document prepared by Iowa State University, January 1992.

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[8]"Bioethics Online Courses for Summer," *Iowa Biotech Educator*, Vol. 12, No. 2, March 2004.

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Appendices

Appendix 2.1

April 22, 1986

To: Representative John Groninga

From: Industry Task Force on Agricultural Biotechnology

Thank you for taking the time yesterday to meet with George Barr (Land O' Lakes), Norman Chambers (Iowa Soybean Promotion Board), John Chrystal (Bankers Trust), Ted Crosbie (Garst), Nick Frey (Pioneer), and Jean Linn (Pioneer). We appreciate your interest in the economic development which results from supporting our existing industry and attracting new industry to Iowa - especially that which results from support of biotechnology research at Iowa State University. Supporting and attracting industry in Iowa is a critical component of maintaining our competitive position in agriculture.

We were especially pleased to learn at the meeting on Monday that the leadership of the House agreed with the need for 5 million dollars for the first funding year for agricultural biotechnology at Iowa State. This funding level will need to continue for the length of the lottery bill to build a quality program which can keep and attract industrial investment in Iowa. On the attached page, we have outlined how the Industry Task Force recommends 5 million dollars be spent during each of the next four years. The budget estimates are based on our industry experiences in conducting or funding our own biotechnology programs. In preparing the budget, the only endowment included was $500,000 to match the Pioneer Chair. The remainder of the support provided by the State of Iowa would be used to initiate and maintain an aggressive and quality research program.

We are grateful that you are willing to give agricultural biotechnology a high priority since we are certain that Iowa State intends to use this investment in the most productive manner possible and that we will be able to provide constructive advice and support to ISU by drawing upon our substantial experience in this area. Members of our Task Force will serve on an Industry Advisory Board for Agricultural Biotechnology that was recently appointed by Iowa State University. Members of the Board will include George Barr (Land O' Lakes), John Chrystal (Bankers Trust), Ted Crosbie (Garst), Robert Erwin (Sungene), Nick Frey (Pioneer), Leroy Hanson (Triple "F"), Charles Lewis (Grain Processing), Chris Nelson (Kemin Industries), Tom Tolbert (Monsanto), and Dean Welch (Salsbury Laboratories). By accepting appointment to this Board, members of industry have made a commitment to advise the university on the research areas that are complimentary to our efforts in producing new and useful products for agriculture. We are committed to cooperate and assist economic development initiatives related to agricultural biotechnology. We are sure that your investment in agricultural biotechnology is a sound decision which will help all Iowa.

Appendix 2.1

Thank you, again, for the confidence you have demonstrated in the industry of Iowa. We are pleased to be partners with you in encouraging economic development within the state.

Mr. Tom Urban
Pioneer Hi-Bred International, Inc.

Dr. Nicholas M. Frey
Pioneer Hi-Bred International, Inc.

Dr. James Radtke
Sungene Technologies Corporation

Dr. Robert Erwin
Sungene Technologies Corporation

Dr. George Barr
Ag Services Research & Development

Dr. Charles J. Lewis
Grain Processing Corporation

Dr. Dwight Tomes
Pioneer Hi-Bred International, Inc.

Mr. John Chrystal
Bankers Trust Company

Dr. Leroy Hanson
Triple "F", Inc.

Mr. John Russell
Garst Seed Company

Dr. Ted Crosbie
Garst Seed Company

Dr. T. L. Tolbert
Monsanto Company

Dr. Dean Welch
Salsbury Laboratories

cc: Senator Art Small

Agricultural Biotechnology

Proposed Budget Prepared by the Industry Task Force

New faculty positions* including $500,000 to match Pioneer Chair in year 1	$2,500,000
Interdisciplinary research grants to stimulate interdisciplinary and intercollegiate research throughout the University	1,000,000
Equipment** Three instrumentation labs to support all biotechnology faculty	1,000,000
Research development for existing faculty whose programs are redirected	500,000
	$5,000,000

*We recommend that new faculty be supported for three years. In addition to faculty salary, research support will include initial equipping of the laboratory, labor, graduate student stipends, and operating supplies. New faculty will be expected to attract federal and industry grant support for graduate student stipends, post-doctoral researchers, and operating expenses by year four. Additional faculty lines should be added as state funds are released and federal and industry grants are attracted.

The goal will be to expand the agricultural biotechnology program over the duration of funding as federal and industry support are drawn to the program.

**Equipment monies in future years will allow ongoing support, including technician salaries and supplies, for the three instrumentation laboratories. It also will allow regular updating of equipment, which is essential in the rapidly evolving field of biotechnology.

Appendix 3.1

April 14, 1986

Establishment and Operation of a Biotechnology Institute at Iowa State University

This document is intended for review by administrators of Iowa State University. It has not been adopted as university policy and should not be published or reproduced.

Prepared by Walter Fehr, Chair, Biotechnology Council

Since 1984, the Biotechnology Council has worked with the administration, faculty, and representatives of industry to organize an effective program in biotechnology for the university. Thanks to the excellent support of the Industry Task Force on Agricultural Biotechnology, it seems likely that the university will receive 5 million dollars beginning July 1, 1986, with the legislative intent that the funding will continue in the future. With this new source of money for the university, it is appropriate to develop an administrative structure for the management of funds for biotechnology from the State of Iowa, and other funds that may be secured from alternative sources.

The administrative plan described in this document is based on the principle established by President Parks, in consultation with other administrators of the university and with the Industry Task Force on Agricultural Biotechnology, that the biotechnology program will be administered on a university-wide basis through the Office of the Vice President for Research. It is intended that the university-wide program will respect the current administrative structure of colleges and departments, while establishing an aggressive intercollegiate and interdepartmental program that involves the Colleges of Agriculture, Engineering, Home Economics, Sciences and Humanities, and Veterinary Medicine.

I. ESTABLISHMENT OF A BIOTECHNOLOGY INSTITUTE

Many universities have established an administrative unit that coordinates the biotechnology program, which is referred to commonly as a center or institute. The administrative unit for biotechnology at Iowa State University will be referred to as the Biotechnology Institute. The Vice President for Research will request approval of the Board of Regents for establishment of the institute.

II. ADMINISTRATION OF THE BIOTECHNOLOGY INSTITUTE

The institute will be administered by a director who is responsible to the Vice President for Research. The director will be advised by a Biotechnology Council, an Industry Advisory Board for Agricultural Biotechnology, and a Research Administration Committee.

A. Appointment Of The Director

The director will be appointed by the Vice President for Research, in consultation with the Biotechnology Council and the deans of the colleges represented on the council. It is not clear if the responsibilities associated with the position will require that the director be on a full-time appointment to the institute. Until this is clearly established, it is recommended that the director initially be on a 75% appointment to the

institute and a 25% appointment to a college and department. The institute will pay 75% and the college 25% of the salary and benefits of the director. The institute will provide to the director adequate administrative support to assure that there is appropriate accounting for institute funds and reporting of institute activities.

B. Biotechnology Council

A council of research faculty at Iowa State University will advise the director. Each council member must have an active program in research related to biotechnology. The council will include members from each of the five colleges, with representation based on the number of faculty engaged in biotechnology research. Based on the 1986 Biotechnology Faculty Directory, there were 137 faculty in the College of Agriculture, 60 in Veterinary Medicine, 36 in Sciences and Humanities, 18 in Engineering, and 10 in Home Economics. Based on this distribution of faculty, the council for 1986-87 will have four members from the College of Agriculture, one from Engineering, one from Home Economics, two from Sciences and Humanities, and two from Veterinary Medicine. For the 1986-87 academic year, the council will be made up of the members who served during 1985-86, plus additional representatives from the College of Agriculture and Veterinary Medicine. Beginning with the 1987-88 academic year, there will be a rotation of council membership. To fill vacancies, the council will recommend to the dean of a college the name of an individual whom it believes could effectively contribute to the council activities. The dean may concur with the recommendation or submit the names of other candidates for consideration by the Vice President for Research, who will make the appointment. The term for an individual will be three years, with at least a one-year period between appointments of the same individual.

The council will serve in an advisory capacity to the director of the institute, and indirectly to the university administration. The council will be responsible for recommending the use of available funds from the State of Iowa and other sources to provide maximum beneficial impact on research in biotechnology at Iowa State University.

C. Industry Advisory Board

Representatives from industries related to agricultural biotechnology will serve on an advisory board. Board members will be recommended by the Biotechnology Council and the college deans to the Vice President for Research, who will appoint the members. The director will convene the board at least two times each year.

D. Research Adminstration Committee

A research administrator from each college will serve on an advisory committee. The research administrators will facilitate communication of institute activities to the college deans and advise the director on administrative issues.

III. DISBURSEMENT OF INSTITUTE FUNDS

Funds for biotechnology that are received from the State of Iowa will be designated as a line item in the university budget.
The funds will be administered by the Biotechnology Institute within the Office of the Vice President for Research. The director of the institute will be responsible to the Vice President for Research for the disbursement

and accounting of the funds. The director will obtain the recommendation of the Biotechnology Council for the disbursement of funds. The director also may request input from the Research Administration Committee, the Industry Advisory Board, and other appropriate faculty and administrators.

The activities to be supported with funds from the institute include the following:

A. Instrumentation Laboratories

The institute will establish, equip, and operate university-wide instrumentation laboratories for major pieces of equipment or for services that are needed by a number of scientists. The faculty will be surveyed to determine the equipment and services that should be offerred by the laboratories. A fee will be charged for use of the laboratories, but they will not be self-supporting. The laboratories will be available, as time permits, to research staff of other state institutions, private colleges and universities, federal agencies, and private companies.

B. Research

The Biotechnology Council will be responsible for selecting the programs that should receive funds to maintain or develop programs of excellence in disciplines related to agricultural biotechnology. The six broad program areas defined by the council are animal breeding, animal growth and development, animal health, plant breeding, plant health, and agricultural and industrial product development.

The council will obtain input from the administration, faculty, representatives of industry, and scientists from other institutions in defining the specific programs that should be funded. University-wide meetings will be held to describe to the faculty the procedure that the council will follow in allocating funds. The information also will be distributed in writing to the biotechnology faculty. There will be three basic steps in the procedure.

Step 1. The departmental executive officers will prepare with their biotechnology faculty, with the departmental executive officers of related departments, and a representative of the Biotechnology Council a description of the programs that should be strengthened to improve the quality of research in biotechnology. The program description should include information on the specific missions or targets that will be addressed by the research, and how they relate to the six focus areas defined by the Biotechnology Council. The description should specify how the faculty and departmental executive officers in a focus area will actively cooperate to meet the program objectives. Emphasis should be placed on the funding of faculty who have demonstrated the capability to conduct and report research in molecular biology or its application to the development of useful products, and have a strong record of research cooperation with other faculty at Iowa State University.

The funds needed to underwrite the programs over a four-year period should be estimated. Funds can be used for equipment not included in the university-wide instrumentation laboratories, supplies, and personnel, including graduate students, technical support persons, and postdoctoral candidates. Funds may not be used for salary or benefits of existing faculty or new faculty. Personnel hired with the funds must be U.S. citizens. The budget descriptions should include the matching funds that

will be provided to underwrite the support available from the institute. The matching funds may represent grants from private or federal sources.

With regard to hiring of new faculty, the institute will provide support to faculty who are hired into existing lines and who would enhance the program areas selected by the council for funding. The institute will provide as a grant to new faculty for each of three years an amount equivalent to her/his salary and benefits, up to $50,000. The funds may be spent for equipment, graduate students, postdoctoral candidates, technical staff or other appropriate research expenditures. The funds can be carried over from one year to the next for up to a total of four years. The following stipulations will apply:

1. The funds will be provided to the scientist upon approval of a project description by the Biotechnology Institute. The project description will include information on (a) the research in molecular biology or its application that the individual will conduct, (b) cooperative research that is planned with other scientists, (c) plans for publishing and reporting the research, and (d) plans for securing additional grant support.
2. The funds may not be used to pay the salary or benefits of the individual. Individuals on a B-base appointment may not use the funds for their salary during the summer.
3. Personnel hired with the funds must be U.S. citizens, including technicans, graduate students, postdoctoral candidates, and hourly labor.
4. The individual will be an active member of a professional society that deals with the application of molecular biology to the development of useful products. Active membership will include invited and contributed papers given at meetings of the society, and publications in journals of the society.
5. Approval of expenditures will be through established departmental, college and university procedures, and will not require the approval of the Biotechnology Institute.
6. An annual report of research activities and an annual accounting of expenditures will be submitted to the Biotechnology Institute.

With regard to new faculty lines, the institute will set aside money each year that can be used as matching funds to establish endowed programs in disciplines related to biotechnology. This topic is discussed further in section IV.

Step 2. The program descriptions will be reviewed by the Biotechnology Council, the Industry Advisory Board, the Research Administration Committee and leading scientists from other institutions.

Step 3. Funds will be distributed to the programs that have the ability to strengthen the university through enhancing the quality of research and graduate education in several departments, to strengthen the research and development efforts of Iowa-based companies, and to encourage the development of new companies or private investments in Iowa.

IV. ENDOWMENTS

The funds from the State of Iowa must be matched with other sources of revenue. It is preferred that the other sources of revenue be donations that can be used to establish endowed programs or chairs in disciplines related to biotechnology. At least two million dollars will be reserved each year as matching funds for endowments. Each endowed program or chair

will be for one million dollars, including $500,000 from the donor(s) and $500,000 from the institute.

A formal request for matching funds from the institute must be approved before a college or department initiates solicitation of funds. When the institute provides matching funds, the endowed programs will be administered jointly by the college or department designated as recipient of the donation and by the institute. If for any reason the endowed program or chair is terminated, half of the funds from the endowment will be distributed to the institute.

The Biotechnology Institute may be the direct recipient of donations for endowments. Endowed programs funded entirely by the institute will be administered by it.

Biotechnology Council Members and the Colleges Represented
The First 25 Years 1984-2009

Appointed 1984	
Alan Atherly	Agriculture
Donald Beitz	Agriculture
Walter Fehr	Agriculture
John Hathcock	Home Economics
John Mayfield	Sciences and Humanities
Peter Reilly	Engineering
James Roth	Veterinary Medicine
Carol Warner	Sciences and Humanities
Appointed 1985	
Pamela White	Home Economics
Appointed 1986	
John Hill	Agriculture
Richard Ross	Veterinary Medicine
Appointed 1987	
Lawrence Arp	Veterinary Medicine
Robert Benbow	Sciences and Humanities
Donald Robertson	Agriculture
Appointed 1988	
Charles Glatz	Engineering
Thomas Ingebritsen	Sciences and Humanities
Allen Trenkle	Agriculture
Appointed 1989	
Richard Hall	Agriculture
Prem Paul	Veterinary Medicine
Ken Prusa	Family and Consumer Sciences (formerly Home Economics)
Appointed 1990	
Therese Cotton	Liberal Arts and Sciences (formerly Sciences and Humanities)
Arnel Hallauer	Agriculture
Ricardo Rosenbusch	Veterinary Medicine
Appointed 1991	
Richard Honzatko	Liberal Arts and Sciences
Susan Lamont	Agriculture
Peter Reilly	Engineering
Appointed 1992	
Charlotte Bronson	Agriculture
Richard Dague	Engineering
Suzanne Hendrich	Family and Consumer Sciences
Michael Taylor	Veterinary Medicine

Appendix 3.2

Appointed 1993	
Michael Lee	Agriculture
Jacob Petrich	Liberal Arts and Sciences
Donald Reynolds	Veterinary Medicine
Appointed 1994	
William Brockman	Engineering
Stephen Ford	Agriculture
Eric Henderson	Liberal Arts and Sciences
Thomas Peterson	Member-at-large
Appointed 1995	
Carole Heath	Engineering
Mirjana Randic	Veterinary Medicine
Robert Serfass	Family and Consumer Sciences
Gregory Tylka	Agriculture
Appointed 1996	
Theodore Kramer	Veterinary Medicine
Patrick Schnable	Agriculture
Edward Yeung	Liberal Arts and Sciences
Appointed 1997	
Douglas Lewis	Family and Consumer Sciences
Christopher Tuggle	Agriculture
Daniel Voytas	Liberal Arts and Sciences
Appointed 1998	
Srdija Jeftinija	Veterinary Medicine
Surya Mallapragada	Engineering
John Obrycki	Agriculture
Appointed 1999	
Janice Buss	Liberal Arts and Sciences
Susan Carpenter	Veterinary Medicine
W. Allen Miller	Agriculture
Appointed 2000	
Charles Brummer	Agriculture
Jay-lin Jane	Agriculture
Eve Wurtele	Liberal Arts and Sciences
Curtis Youngs	Agriculture
Appointed 2001	
Mark Ackermann	Veterinary Medicine
Kevin Schalinske	Family and Consumer Sciences
Appointed 2002	
Vlastik Bracha	Veterinary Medicine
David Hannapel	Agriculture
Jorgen Johansen	Liberal Arts and Sciences
Balaji Narasimhan	Engineering

Appointed 2003	
Thomas Baum	Agriculture
John Nason	Liberal Arts and Sciences
James Reecy	Agriculture
Appointed 2004	
Diane Birt	Family and Consumer Sciences
Gregory Phillips	Veterinary Medicine
Appointed 2005	
Bryony Bonning	Agriculture
Gloria Culver	Liberal Arts and Sciences
Anumantha Kanthasamy	Veterinary Medicine
Brent Shanks	Engineering
Appointed 2006	
Adam Bogdanove	Agriculture
Donald Sakaguchi	Liberal Arts and Sciences
Michael Spurlock	Agriculture
Appointed 2007	
Lee Alekel	Human Sciences (formerly Family and Consumer Sciences)
Diane Bassham	Liberal Arts and Sciences
Qijing Zhang	Veterinary Medicine
Appointed 2008	
William Beavis	Agriculture and Life Sciences (formerly Agriculture)
Richard Martin	Veterinary Medicine
Matthew Rowling	Human Sciences
Jacqueline Shanks	Engineering
Appointed 2009	
Jack Dekkers	Agriculture and Life Sciences
Mark Hargrove	Liberal Arts and Sciences
Steven Whitham	Agriculture and Life Sciences

Appendix 3.3

Office of Biotechnology Staff

The First 25 Years 1984-2009

Name	Years of Service	Title (most recent)
Walter Fehr	1984-2009	Director
James Reecy	2009-present	Director
Susana Alvarez Bucklin	1996-2002	Account Specialist
Alan Andersen	1991-1993	Graduate Assistant
Julia Betts	1994	Secretary
Lora Bierbaum	2003-present	Program Assistant
Danelle Baker-Miller	1997-1999	Program Assistant
Linda Brinkmeyer	1991	Secretary
Anne Byrne	2001-present	Accountant
Lynette Edsall	2000-2002	Program Assistant
Kristen Hessler	2002-2006	Lecturer – Bioethics Outreach Education Coodinator
Dena Huisman	1999-2004	Program Assistant
Linda Kennedy	1984-1987	Secretary
Sheila Lacy	1992-1996	Program Coordinator
Lisa Lorenzen	1999-present	Director of Industry Relations
Debbra Matney	1994-1996	Account Clerk
Priscilla Matt	1988-1992	Secretary
Yolanda Martin	1991-1992	Secretary
Lori Miller	1992-present	Secretary
Marilyn Peterson	1987-1998	Administrative Specialist
Teresa Peterson	1998-2007 2008-present	Administrative Specialist
Steven Price	1988-1992	Biotechnology Liaison
Keith Redenbaugh	1997-1998	Industrial Liaison
Camie Stockhausen	2004-present	Communications Specialist
Sue Sullivan	1996	Temporary Industry Liaison
Susan Voynow	1992-1995	Industrial Liaison
Glenda Webber	1986-1991 1995-present	Program Coordinator
Michael Zeller	2000-present	Program Coordinator – Biotechnology Outreach Education Coordinator

Note: Any inaccuracies are unintentional.

Office of Biotechnology Instrumentation Facilities
Professors-in-Charge and Personnel

The 13 facilities listed are the ones that have received financial support from the Office of Biotechnology. The date refers to when Biotech began providing financial support. The professors-in-charge and employees after the support date appear in the order in which they assumed their duties. Any inaccuracies in the listings are unintentional. Current professors-in-charge and employees as of June 30, 2009, are asterisked (*). Biotech has provided support for equipment or other activities to additional instrumentation facilities that it does not manage and which do not appear in this listing.

FLOW CYTOMETRY FACILITY (formerly Cell Sorting Center, Cell Facility) – supported 1986
Professor-in-Charge
- Carol Warner
- Marit Nilsen-Hamilton
- James A. Olson
- Stephen Ford
- Michael Wannemuehler*

HYBRIDOMA FACILITY – supported 1989
Incorporated into the Office of Biotechnology instrumentation facilities in 1989 and merged with the Cell Facility from 1993-2000.

Professor-in-Charge
- Richard Van Deusen
- Stephen Ford
- Michael Wannemuehler*

Employees of either the Flow Cytometry Facility or the Hybridoma Facility while merged or separate
- Vickie Hall
- Kristi Harkins
- Padmasree Chigurupati
- Patricia Jenkins
- Jeff Clapper
- Donna Maslak
- Paul Kapke*
- Donghui Cheng
- Christine Deal*
- Shawn Rigby*
- Amanda Brockman*

DNA FACILITY – supported 1986
Professor-in-Charge
- Robert Benbow
- Walter Fehr*

Employees
- Carol Manthey
- Deborah Stowers
- John Bell
- Judy Lundy
- Melvin Duvall

Harold Hills
Gary Polking*
Wen-Chy Chu
Jeanne Budgin
Melissa Emrich
Melissa Aaron
Stephanie Nelson
Amy Wagner
Jose Gatica
Jonathan Mlocek*
Vicki Parks
Prabhjit Chada-Mohanty
Rick Finger
Joel Hansen
Nicole Benton
Kevin Cavallin*
Michael Baker*
Elizabeth Weishaar
Tru Twedt
Rachel Binning
Diane Shogren*
Gregory Kramer*
Adam Janssen*

PROTEIN FACILITY – supported 1986
Professor-in-Charge
Donald Graves
Louisa Tabatabai
Walter Fehr/Alan Myers
Walter Fehr*

Employees
Shirley Elliott
Juan Li
Xia-Ying Zhou
Jesse Figgins
Siquan Luo
Joel Nott*
Chu-Xiong Liao
Amanda Brockman*
Margaret Carter*

FERMENTATION FACILITY – supported 1987
Professor-in-Charge
Peter Reilly
Bonita Glatz
Anthony Pometto III
Lawrence Johnson*

Employees
John Strohl*
Ben Voss
Jelena Jeremic
Carol Ziel

IMAGE ANALYSIS FACILITY – supported 1988
Professor-in-Charge
Lawrence Arp
Carol Jacobson
Mary Helen Greer
Mark Ackermann*

Employees
Margaret Carter*
Joel Nott

MICROSCOPY AND NANOIMAGING FACILITY (formerly Bessey Microscopy Facility) – supported 1989
Professor-in-Charge
Harry T. (Jack) Horner, Director*

Employees
Bruce L. Wagner
Tracey M. Pepper*
John Mattila
Randall Denadel*

NUCLEAR MAGNETIC RESONANCE FACILITY – supported 1989
Professor-in-Charge
Agustin Kintanar

Employees
R. David Scott
Wayne Baker
Bruce Fulton*

PLANT TRANSFORMATION FACILITY – supported 1996
Professor-in-Charge
Kan Wang, Director*

Employees
Bronwyn Frame*
Hong Wang
Hongyi Zhang
Kalyani Dias
Shifu Zhen
Shirley Li
Diane Luth*
Karen Sellers
Lise Marcell
Rose Schick*
Sue Ellen Pegg
Z. B. Gordon Guo
Zhanyuan Zhang
Baochun Li
Anjan Banerjee

Jennifer McMurray
Lorena Moeller*
Margie Paz
Marcy Main*
Xiaoyun Tang
Andrea Kalvig
Helene Eckert
Jennie Lund
Yan Jin*
Qinglei Gan*
Xinyuan Zhao*
Tina Paque

CONFOCAL MICROSCOPY FACILITY – supported 1997
Professor-in-Charge
Mark Ackermann*

Employees
Margaret Carter*

GENECHIP® FACILITY – supported 2002
Professor-in-Charge
Steven Whitham*

Employees
Jiqing Peng*

W. M. KECK METABOLOMICS RESEARCH LABORATORY – supported 2007
Professor-in-Charge
Basil Nikolau*

Employees
Ann Perera*

MACROMOLECULAR X-RAY CRYSTALLOGRAPHY FACILITY – supported 2007
Professor-in-Charge
Richard Honzatko*

Employees
Julie Hoy*

Interoffice Communication | IOWA STATE UNIVERSITY of Science and Technology

DATE: March 14, 1989

TO: Dr. Gordon P. Eaton
117 Beardshear

Dr. Norman Jacobson
201 Beardshear

Dr. Carol Bradley
117 Beardshear

Dean David Topel
124 Curtiss

FROM: Milton D. Glick
Provost
110 Beardshear

The attached memorandum regarding Agricultural Biotechnology at Iowa State University is an important element in Iowa State's efforts to substantially enhance agricultural research at Iowa State in general, and agricultural biotechnology in particular. As you are aware, Dean Topel and we agree that the Agricultural Experiment Station should provide support for agricultural related research throughout the University, not just in the College of Agriculture. His commitment to this has been made clear by both his public statements and his actions. As part of this effort, we have been discussing the best way to continue the very successful Agricultural Biotechnology program. We have agreed, per the attached policy, that it will be more effective to incorporate legislative requests for Agricultural Biotechnology within the Agricultural Experiment Station request rather than separately. As you see, we have further agreed that the funding for Agricultural Biotechnology through the Experiment Station will be allocated by the Agricultural Biotechnology Council which will be appointed by the Vice Provost for Research and Advanced Studies and will report jointly to him or her and to the Director of the Agricultural Experiment Station.

We have further agreed that of the base enhancement for FY90, at least 40% of this enhancement will be allocated to the Agricultural Biotechnology Council and a similar fraction of the FY91 AES funding enhancement. This is meant to be an on-going base commitment to the Agricultural Biotechnology Council.

Dean Topel, Associate Provost Jacobson, and I have all concurred that this is the best way to protect and grow the already successful program on our campus.

MDG:njm
mdg545

Appendix 5.1

POLICY REGARDING AGRICULTURAL BIOTECHNOLOGY

Iowa State University is committed to a substantial enhancement of agricultural research, including financial support for agricultural research in all Colleges on the Iowa State campus. This is a broad based program which will require the cooperative efforts of key faculty throughout the University, especially in the College of Agriculture, and support groups throughout the state. It is important to emphasize that this will be a broad based program, which is inclusive of faculty with both basic and applied research relevant to agriculture, in any of our eight colleges.

To support the effort to enhance and upgrade agricultural research, the University is pursuing a five-year program to increase the Agricultural Experiment Station base budget by $3 million each year for a total base increase over five years of $15 million. The state has already committed considerable resources in biotechnology through the $17 million 4-year lottery funded program in agricultural biotechnology and through the $30 million molecular biology building. The agricultural biotechnology program has been a campus-wide program coordinated and supervised by a campus-wide committee. This committee and its chair were appointed originally by the Vice President for Research. The success of this program must be continued. In order to reduce destructive competition at the legislature, it is agreed that the agricultural biotechnology program shall be funded through Experiment Station increases rather than seeking further direct appropriations. It is further agreed that pre-agreed upon fraction of increases from state funds to the Agricultural Experiment Station (not including inflation) shall be dedicated to agricultural biotechnology. These funds will be allocated by the Agricultural Biotechnology Council which will be appointed by the Vice Provost for Research and Advanced Studies and will report jointly to the Vice Provost for Research and Advanced Studies and to the Director of the Agricultural Experiment Station. If the Director of the Agricultural Experiment Station or the Vice Provost for Research and Advanced Studies do not both approve of an allocation recommendation by the Agricultural Biotechnology Council, this shall be resolved by the Provost, or if necessary, the President.

MDG:DH
mdg301

BIOTECHNOLOGY PROGRAM

BUDGET	FY1984	FY1985	FY1986	FY1987	FY1988
ENDOWMENT ESTABLISHMENT					$1,000,000.00
ADMINISTRATION				$0.00	$0.00
TECHNOLOGY TRANSFER				$280,000.00	$295,000.00
INSTRUMENTATION FACILITIES				$150,000.00	$475,000.00
FACULTY STARTUP				$1,200,000.00	$1,350,000.00
FELLOWSHIPS				$300,000.00	$100,000.00
FACULTY DEVELOPMENT				$30,000.00	$30,000.00
COMPETITIVE GRANTS(Current Faculty Research)				$1,740,000.00	$950,000.00
BIOETHICS				$50,000.00	$50,000.00
PIONEER HI-BRED MATCH			$500,000.00		
TOTAL	**$0.00**	**$0.00**	**$500,000.00**	**$3,750,000.00**	**$4,250,000.00**

BUDGET	FY1989	FY1990	FY1991	FY1992	FY1993
ENDOWMENT ESTABLISHMENT	$2,000,000.00	$2,000,000.00			
ADMINISTRATION	$0.00	$0.00	$0.00	$261,000.00	$250,220.00
TECHNOLOGY TRANSFER	$357,500.00	$295,000.00	$325,000.00	$116,000.00	$150,000.00
INSTRUMENTATION FACILITIES	$475,000.00	$975,000.00	$525,000.00	$520,000.00	$520,000.00
FACULTY STARTUP	$600,000.00	$850,000.00	$490,000.00	$314,939.00	$534,500.00
FELLOWSHIPS	$200,000.00	$50,000.00	$100,000.00	$62,000.00	$62,000.00
FACULTY DEVELOPMENT	$30,000.00	$30,000.00	$30,000.00	$20,000.00	$20,000.00
PUBLICATIONS	$0.00	$0.00	$0.00	$0.00	$0.00
PUBLIC EDUCATION	$0.00	$0.00	$0.00	$0.00	$0.00
COMPETITIVE GRANTS	$537,500.00	$0.00	$75,000.00	$100,000.00	$0.00
BIOETHICS	$50,000.00	$50,000.00	$100,000.00	$100,000.00	$100,000.00
TOTAL	**$4,250,000.00**	**$4,250,000.00**	**$1,645,000.00**	**$1,493,939.00**	**$1,636,720.00**

BUDGET	FY1994	FY1995	FY1996	FY1997	FY1998
ADMINISTRATION	$215,000.00	$225,000.00	$225,000.00	$225,000.00	$230,000.00
TECHNOLOGY TRANSFER	$150,000.00	$150,000.00	$100,000.00	$100,000.00	$165,000.00
INSTRUMENTATION FACILITIES	$534,000.00	$575,000.00	$625,000.00	$625,000.00	$650,000.00
FACULTY STARTUP	$570,000.00	$550,000.00	$550,000.00	$550,000.00	$550,000.00
FELLOWSHIPS	$52,000.00	$75,000.00	$75,000.00	$75,000.00	$75,000.00
FACULTY DEVELOPMENT	$10,000.00	$0.00	$10,000.00	$10,000.00	$10,000.00
PUBLICATIONS	$56,000.00	$0.00	$60,000.00	$60,000.00	$72,400.00
PUBLIC EDUCATION	$16,000.00	$145,000.00	$75,000.00	$75,000.00	$64,000.00
COMPETITIVE GRANTS	$0.00	$280,000.00	$200,000.00	$200,000.00	$300,000.00
BIOETHICS	$75,000.00	$75,000.00	$75,000.00	$75,000.00	$100,000.00
UTILITIES REVERSION	$79,000.00	$0.00	$80,000.00	$80,000.00	$80,000.00
TOTAL	**$1,757,000.00**	**$2,075,000.00**	**$2,075,000.00**	**$2,075,000.00**	**$2,296,400.00**

BUDGET	FY1999	FY2000	FY2001	FY2002	FY2003
ADMINISTRATION	$230,000.00	$235,000.00	$246,000.00	$268,000.00	$268,000.00
TECHNOLOGY TRANSFER	$165,000.00	$181,000.00	$181,000.00	$196,500.00	$169,000.00
INSTRUMENTATION FACILITIES	$675,000.00	$725,000.00	$770,000.00	$770,000.00	$770,000.00
FACULTY STARTUP	$600,000.00	$600,000.00	$700,000.00	$750,000.00	$750,000.00
FELLOWSHIPS	$75,000.00	$130,000.00	$100,000.00	$100,000.00	$100,000.00
FACULTY DEVELOPMENT	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00
PUBLICATIONS	$75,000.00	$79,000.00	$79,000.00	$52,200.00	$74,700.00
PUBLIC EDUCATION	$64,000.00	$100,000.00	$100,000.00	$89,000.00	$89,000.00
COMPETITIVE GRANTS	$300,000.00	$300,000.00	$200,000.00	$150,000.00	$0.00
BIOETHICS	$86,896.00	$60,000.00	$81,790.00	$56,500.00	$56,500.00
UTILITIES REVERSION	$80,000.00	$80,000.00	$80,000.00	$80,000.00	$80,000.00
TOTAL	**$2,360,896.00**	**$2,500,000.00**	**$2,547,790.00**	**$2,522,200.00**	**$2,367,200.00**

6/24/2009

Appendix 5.2

BIOTECHNOLOGY PROGRAM

BUDGET	FY2004	FY2005	FY2006	FY2007	FY2008
ADMINISTRATION	$286,000.00	$300,000.00	$300,000.00	$271,880.00	$255,290.00
TECHNOLOGY TRANSFER	$173,000.00	$173,000.00	$175,000.00	$92,287.00	$100,420.00
INSTRUMENTATION FACILITIES	$790,000.00	$897,790.00	$730,436.00	$679,057.00	$673,384.00
FACULTY STARTUP	$750,000.00	$750,000.00	$525,000.00	$525,000.00	$525,000.00
FELLOWSHIPS	$100,000.00	$200,000.00	$200,000.00	$200,000.00	$200,000.00
FACULTY DEVELOPMENT	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
PUBLICATIONS	$78,500.00	$100,000.00	$123,000.00	$121,200.00	$126,000.00
PUBLIC EDUCATION	$93,500.00	$107,000.00	$129,000.00	$122,550.00	$127,000.00
COMPETITIVE GRANTS	$0.00	$0.00	$0.00	$0.00	$0.00
BIOETHICS	$18,600.00	$71,800.00	$90,200.00	$85,690.00	$39,300.00
UTILITIES REVERSION	$80,000.00	$80,000.00	$80,000.00	$80,000.00	$80,000.00
TOTAL	**$2,384,600.00**	**$2,694,590.00**	**$2,367,636.00**	**$2,192,664.00**	**$2,141,394.00**
BUDGET	**FY2009**	**FY2010***			
ADMINISTRATION	$223,861.00	$222,246.00			
TECHNOLOGY TRANSFER	$102,346.00	$71,154.00			
INSTRUMENTATION FACILITIES	$762,256.00	$682,821.00			
FACULTY STARTUP	$550,000.00	$450,000.00			
FELLOWSHIPS	$200,000.00	$100,000.00			
FACULTY DEVELOPMENT	$15,000.00	$13,500.00			
PUBLICATIONS	$135,400.00	$132,561.00			
PUBLIC EDUCATION	$132,700.00	$137,251.00			
BIOETHICS	$40,000.00	$37,500.00			
UTILITIES REVERSION	$80,000.00	$0.00			
TOTAL	**$2,241,563.00**	**$1,847,033.00**			

*Budget expenditures for FY2010 began July 1, 2009.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Office of Biotechnology
1210 Molecular Biology Building
Ames, Iowa 50011-3260
515 294-9818
FAX 515 294-4629

Date: May 18, 2005

To: Ted Okiishi

From: Walter Fehr

Thank you for taking the time today to meet with past and current members of the Biotechnology Council as part of the internal review of the Office of Biotechnology. The persons in attendance were:

Past Council Members	
Ackermann, Mark	Veterinary Pathology
Bracha, Vlastik	Biomedical Sciences
Bronson, Charlotte	Plant Pathology
Buss, Janice	Biochemistry, Biophysics, and Molecular Biology
Hannapel, David	Horticulture
Hill, John	Plant Pathology
Johansen, Jorgen	Biochemistry, Biophysics, and Molecular Biology
Mallapragada, Surya	Chemical and Biological Engineering
Miller, Allen	Plant Pathology
Narasimhan, Balaji	Chemical and Biological Engineering
Reilly, Peter	Chemical and Biological Engineering
Rosenbusch, Ricardo	Veterinary Microbiology and Preventive Medicine
Schalinske, Kevin	Food Science and Human Nutrition

Current Council Members	
Baum, Thomas	Plant Pathology
Birt, Diane	Food Science and Human Nutrition
Bonning, Bryony	Entomology
Culver, Gloria	Biochemistry, Biophysics, and Molecular Biology
Fehr, Walter	Chair, Agronomy
Kanthasamy, Anumantha	Biomedical Sciences
Phillips, Gregory	Veterinary Microbiology and Preventive Medicine
Reecy, James	Animal Science
Shanks, Brent	Chemical and Biological Engineering

You asked the Council members to comment on three questions. At your request, I am summarizing their responses to the questions at the meeting today.

Appendix 5.3

1. ***What priority would you assign to the various activities that the Office of Biotechnology supports, which include faculty start-up, technology transfer, instrumentation facilities, graduate fellowships, faculty development, publications, public education, and bioethics? What program activities do you think the Office of Biotechnology should support five years from now and how would you assign priorities to those activities?***

   There was consensus that the highest priority activity of the Office of Biotechnology is management of the Biotechnology Instrumentation Facilities. The facilities are a critical resource to faculty and students on campus. They are very important for the recruitment of new faculty, postdocs, and graduate students. The services of the facilities are reviewed throughout the year as new instrumentation becomes available. They are reviewed in detail by the Council as part of the budget process that is held in February each year. Although it is difficult to determine what services the facilities will provide five years from now, the constant review by the Council of the instrumentation needs of our faculty and students will assure that Iowa State University remains at the cutting edge of biotechnology research.

   There was consensus that the second highest priority is the start-up support for new faculty. The availability of start-up funds for new hires in molecular biology sends a clear message to departments and colleges that molecular biology is a priority area for the university. The decision as to which research areas in molecular biology should be emphasized in the university is considered by the Council to be the responsibility of the departments and colleges. The Council members do not feel it should be the role of the Office of Biotechnology to determine the areas of research emphasis. Instead, the Office should continue to support any department or college that decides to make molecular biology an emphasis in new faculty hires.

   Although there was no consensus on the third priority, the greatest support among Council members was for graduate fellowships because they are critical for recruiting top students. The Council members indicated that the funds for graduate fellowships from the Office of Biotechnology are unique in that they are available for both domestic and foreign students. They provide an opportunity to compete financially with other institutions for the best students.

   There was support from one or more Council members for all the other budget categories. This is consistent with the reaction of the Council during each annual budget review. At that review, every section of the budget is examined in detail as to its importance for Iowa State University.

   With regard to the program activities that will be important in five years, the Council could not predict what changes were likely to occur. They believe that Iowa State University will remain a leader in biotechnology research if it maintains the current administrative structure for the Office of Biotechnology. Through the constant review of the university's program by the Biotechnology Council and the Vice Provost for Research, the university will be able to adapt to changes in molecular biology that will occur over time. The Council is made up of

top researchers from five colleges who are at the forefront of biotechnology research. They are the best persons on campus to provide recommendations on future program changes. The leadership that Iowa State University enjoys in biotechnology is a testament to the value of the Council during the past 20 years.

2. ***What do you consider to be the current vision, mission, and major goals of the Office of Biotechnology? How do you think these will change over the next five years?***

   The definition of biotechnology adopted by the first Biotechnology Council in 1984 continues to provide a good mission statement. "Biotechnology is the application of molecular biology to the development of useful products and processes." The goal of the Council since its inception has been to strengthen the entire university in research, education, and outreach. The focus on molecular biology and the overall goals of the program are not expected to change during the next five years. As new discoveries are made, the Biotechnology Council will provide recommendations for program activities that will keep the university at the forefront of biotechnology.

3. ***How do you propose handling predicted budget shortfalls? New sources of revenue? Other strategies?***

   The Council members were in unanimous support of centralized administration of the biotechnology program through the Vice Provost for Research and the Office of Biotechnology. There was no support for dividing the available funds for biotechnology among departments and colleges. It was made clear that if President Eaton had decided to divide up the 17 million dollars of initial funding in 1986 to the five colleges, the success that we enjoy today in biotechnology would never have been realized. Centralized administration and funding for the program will continue to be critical.

   The inevitability of budget shortfalls was questioned. The current concern over budget shortfalls is the result of a departure from the funding plan that was established by President Eaton and that was continued until two years ago. The biotechnology industry of Iowa was effective in convincing Governor Branstad and the legislature that 17 million dollars should be provided to the biotechnology program over a four-year period beginning in 1986. President Eaton decided that the funds should be administered centrally by the Vice President for Research. Vice President Zaffarano decided to ask the Biotechnology Council to recommend how the funds should be spent. The model that Dr. Zaffarano established has been used by every Vice President (Provost) for Research since 1986. The Council reviews all requests for funds and makes a recommendation to the Vice Provost. The Vice Provost decides whether or not to concur with the recommendation. If she/he concurs, the Office of Biotechnology implements the program activity.

   When the end of the initial four-year funding from the State of Iowa drew near, President Eaton held a meeting of relevant administrators on campus to discuss how to obtain continued funding for the programs of the Office of Biotechnology. Two options were discussed. One option was to establish a budget line for biotechnology and to ask the biotechnology industry to assist with obtaining funds from the state. This was an attractive

option because the biotechnology industry had been instrumental in getting the initial funding of 17 million dollars in 1986 and lobbied effectively during the next legislative session for 30.5 million dollars to construct the Molecular Biology Building. The problem with the option was that the university was requesting 15 million dollars in new funds for the Agriculture Experiment Station (AES), commonly known as the 3 x 5 program. President Eaton was concerned that a new budget line for biotechnology and additional funding for AES might be difficult to achieve. He decided that the biotechnology industry should be asked to support the 3 x 5 program for the AES, with the understanding that part of the new money would pass through the AES to the Vice President for Research. The plan is described in the attached memo written by Provost Glick on March 14, 1989.

After the initial funding from the state for the Office of Biotechnology was established, the annual amount that passed through the AES to the Vice Provost was adjusted by approximately the same percentage as the percentage change in state funds to the AES. As evidence of this arrangement, please note the attached memo of August 14, 1991, from Thomas Fretz to Patricia Swan that illustrates that funds for the Office of Biotechnology were adjusted in accordance with changes in the AES funds from the state. This strategy worked very well for many years. The Biotechnology Council was able to develop its annual budget recommendations for the Vice Provost because it knew approximately how much it would receive from the state.

The funding from the state that passed through the AES to the Vice Provost for the Office of Biotechnology was disrupted in FY2004, as indicated in the table below. In FY2004, the budget book of the university indicated that the Office of Biotechnology received $1,629,872. In reality, the AES provided only $1,029,872, which represented a $575,724 reduction (35.9% reduction) from the FY2003 allocation of $1,605,596. The reduction in the FY2004 state allocation to the AES was only 2.7%. The AES indicated that its percentage reduction was more than 2.7% because it had to reallocate funds to cover salary increases. However, the total amount of salary increases for staff of the Office of Biotechnology totaled only $13,795. If the Office of Biotechnology had covered all the salary increases of its staff, it should have received $1,616,077 ($1,629,872 - $13,795). This meant that the AES was using funds that were supposed to go to the Office of Biotechnology to cover the salaries increases of individuals unrelated to the Office of Biotechnology. This disproportionate reduction in funds to the Office of Biotechnology represented a significant reduction in the resources available to faculty and students in the other four colleges that are served by the Office of Biotechnology. Those four colleges were denied the opportunity to benefit from the university-wide programs those funds could have supported.

The drastic reduction in funds in FY2004 was considered by the AES to be permanent. For FY2005, the budget book indicates that the allocation to the Office of Biotechnology was only $960,009. The actual amount received was $175,000 more because of a one-time allocation provided from the AES that was not reflected in the budget book.

Because the AES considers the FY2004 decrease in funds to the Office of Biotechnology to be permanent, the reduction in funds to the Office of Biotechnology and to the other four colleges has resulted in the budget shortfall that was discussed at the meeting with you today.

Appendix 5.3

	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
State funds to AES	$34,982,675.00	$36,252,371.00	$37,029,596.00	$36,156,441.00	$32,712,448.00	$31,814,892.00	$31,019,520.00
% Change	+3.6	+3.6	+2.1	-2.4	-9.5	-2.7	-2.5
AES pass through funds to biotech based on budget book	$1,818,737.00	$1,858,576.00	$1,840,447.00	$1,752,761.00	$1,605,596.00	$1,629,872.00	$960,009.00
% Change	+2.2	+2.2	-1.0	-4.8	-8.4	+1.5	-41.1
Actual funds received by biotech from AES	$1,818,737.00	$1,858,576.00	$1,840,447.00	$1,752,761.00	$1,605,596.00	$1,029,872.00	$1,135,009.00
% Change		+2.2	-1.0	-4.8	-8.4	-35.9	+10.2
$ Change		$39,839.00	($18,129.00)	($87,686.00)	($147,165.00)	($575,724.00)	$105,137.00

Appendix 5.4

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Office of Biotechnology
1210 Molecular Biology Building
Ames, Iowa 50011-3260
515 294-9818
FAX 515 294-4629

May 23, 2005

To: President Geoffroy
Provost Allen

From: Walter Fehr

On Wednesday, May 18, the past and current members of the Biotechnology Council met with Dr. Ted Okiishi, chair of the committee that is reviewing the programs of the Office of Biotechnology. I asked him to meet with the Council to gain the perspective of our leading biotechnology researchers regarding three questions he wanted the Office of Biotechnology to address. At the end of the meeting, Dr. Okiishi asked me to write a summary of the Council perspective, a copy of which is enclosed.

It was clear at the meeting that the past and current members of the Biotechnology Council are extremely proud of the biotechnology program that they have played a key role in developing for our university. It also was clear that they have sincere concern about whether the excellence in biotechnology that our university enjoys as a result of their effort for the past 21 years will be sustained in the future.

The reason for their concern is generated by the fact that in FY2005 for the first time in 20 years, the budget recommendation of the Biotechnology Council to the Vice Provost was not fully funded. The budget recommendation was $2,694,590, and the amount provided to the Vice Provost for the program was $2,334,600, based on the memo of Feb. 2, 2005, from Provost Allen. The available funds were increased by $125,000 this spring, which was very much appreciated.

The prospect of a reduction in the biotechnology program for another year is very difficult to consider because the Council has been so faithful over the years in recommending an aggressive program for the university that was consistent with the resources that were available to the Vice Provost. I attached to the summary for Dr. Okiishi the 1989 memo from Provost Glick that described how the biotechnology programs of the Office of Biotechnology would be funded after the initial four-year period. Every year, the Council has recommended a budget to the Vice Provost that was consistent with the funds that passed through the Agriculture Experiment Station and the funds from the endowment interest.

You are well aware of what happened to the biotechnology funds in FY2004 and FY2005. At the request of Dr. Okiishi, I explained in the memo to him what happened.

The budget recommendation of the Council to Vice Provost Bloedel for FY2006 is $2,592,636. As chair of the Biotechnology Council, I am requesting that the request be fully funded. If you need any details about the budget recommendation, please do not hesitate to contact me.

Thank you for considering this request.

cc. Vice Provost Bloedel
Biotechnology Council

Note to Reader: Enclosures referred to in this letter appear earlier in the Appendices.

STATE OF IOWA

GENERAL ASSEMBLY

SENATE CONCURRENT RESOLUTION NO. 35

A CONCURRENT RESOLUTION
RELATING TO THE BOARD OF REGENTS TEN-YEAR BUILDING PROGRAM.

WHEREAS, pursuant to section 262A.3, the state board of regents prepared and within seven days after the convening of the Seventy-second General Assembly of the State of Iowa, First Session, submitted to the Seventy-second General Assembly, First Session, for approval the proposed ten-year building program for each institution of higher learning under the jurisdiction of the board, containing a list of the buildings and facilities which the board deems necessary to further the educational objectives of the institutions, together with an estimate of the cost of each of the buildings and facilities and an estimate of the maximum amount of bonds which the board expects to issue under chapter 262A for each year of the fiscal biennium beginning July 1, 1987, and ending June 30, 1989; and

WHEREAS, the projects contained in the building program are deemed necessary for the proper performance of the instructional, research, and service functions of the institutions; and

WHEREAS, section 262A.4 provides that the state board of regents, after authorization by a constitutional majority of each house of the General Assembly and approval by the Governor, may undertake and carry out at the institutions of higher learning under the jurisdiction of the board any project as defined in chapter 262A; and

WHEREAS, chapter 262A authorizes the state board of regents to borrow money and to issue and sell negotiable revenue bonds to pay all or any part of the cost of carrying out projects at any institution payable solely from and secured by an irrevocable pledge of a sufficient portion of the student fees and charges and institutional income received by the particular institution; and

WHEREAS, to further the educational objectives of the institutions, and to foster economic growth in this state, the state board of regents requests authorization to undertake and carry out certain projects at this time and to finance their costs by borrowing money and issuing negotiable bonds under chapter 262A in a total amount not exceeding sixty-five million six hundred thousand (65,600,000) dollars, the remaining cost of the projects to be financed by capital appropriations or by federal or other funds lawfully available; NOW THEREFORE,

BE IT RESOLVED BY THE SENATE, THE HOUSE CONCURRING, That the proposed ten-year building program submitted by the state board of regents for each institution of higher learning under its jurisdiction is approved; and

BE IT FURTHER RESOLVED, That no commitment is implied or intended by approval to fund any portion of the proposed ten-year building program submitted by the state board of regents beyond the portion that is financed and approved by the Seventy-second General Assembly, First Session, and the Governor; and

BE IT FURTHER RESOLVED, That during the biennium which commences July 1, 1987, and which ends June 30, 1989, the maximum amount of bonds which the state board of regents expects to issue under chapter 262A, unless additional bonding is authorized, is sixty-five million six hundred thousand (65,600,000) dollars, all or any part of which may be issued during the fiscal year ending June 30, 1988, and if all of that amount should not be issued during that fiscal year, any remaining balance may be issued during the fiscal year ending June 30, 1989, or thereafter, and this plan of financing is approved; and

BE IT FURTHER RESOLVED, That the state board of regents is authorized to undertake, plan, construct, equip, and otherwise carry out the following projects and to pay all or any part of the cost of carrying out the projects by borrowing money and issuing negotiable revenue bonds under chapter 262A during the fiscal year beginning July 1, 1987, except as otherwise provided in this resolution, in a total amount not to exceed sixty-five million six hundred thousand (65,600,000) dollars:

State University of Iowa	$ 25,100,000
Laser laboratories	
International center (old law center) remodeling	
Cost of issuance of bonds	
Iowa State University	$ 37,500,000
Molecular biology building	
Home economics building-phase I	
Meat irradiation facility	
University research park development	
Industrial education remodeling	
Veterinary medicine research institute laboratory	
Cost of issuance of bonds	
University of Northern Iowa	$ 3,000,000
Latham hall remodeling	
Cost of issuance of bonds	
Total	$ 65,600,000

BE IT FURTHER RESOLVED, That if the amount of bonds issued under this resolution exceeds the actual costs of projects approved in this resolution, the amount of the difference shall be used to pay the principal and interest due on bonds issued under chapter 262A.

JO ANN ZIMMERMAN
President of the Senate

DONALD D. AVENSON
Speaker of the House

I hereby certify that this bill originated in the Senate and is known as Senate Concurrent Resolution 35, Seventy-second Seventy-second General Assembly.

JOHN F. DWYER
Secretary of the Senate

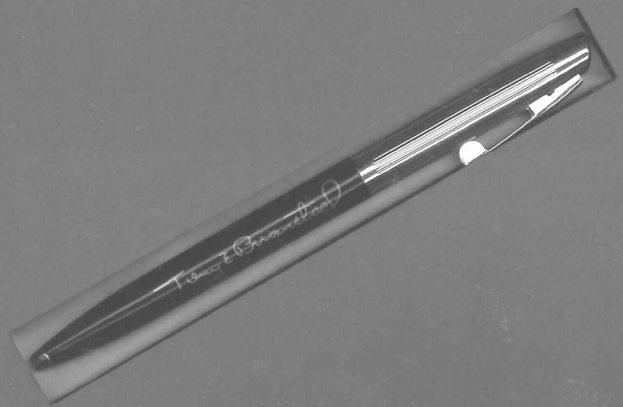
Approved June 9, 1987

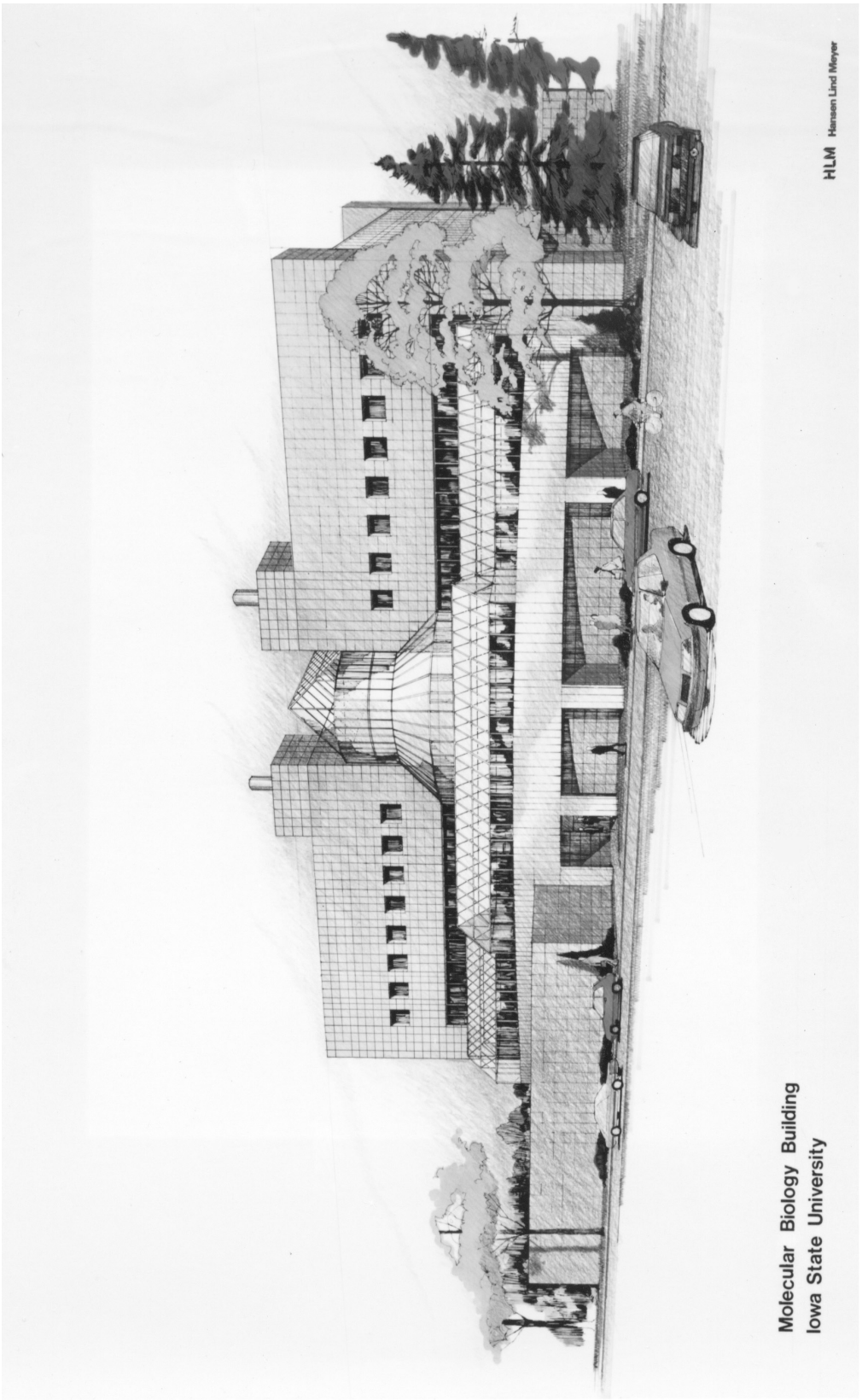
TERRY E. BRANSTAD
Governor

Appendix 6.1

Signing of Senate Concurrent Resolution No. 35
June 9, 1987

Individuals and their affiliations at the time of the signing, left to right: (1) Douglas True, Director of Business and Finance, Board of Regents; (2) Gordon Eaton, President, Iowa State University; (3) Tom Bauer, Associate Director of University Relations, University of Iowa; (4) Walter Fehr, Biotechnology Coordinator and Professor of Agronomy, Iowa State University; (5) Terry E. Branstad, Governor of the State of Iowa; (6) Dennis Olson, Professor-in-Charge of Meat Export Research Center, Iowa State University; (7) R. Wayne Richey, Executive Secretary, Board of Regents; (8) D. C. Spriestersbach, Vice President for Educational Development and Research and Dean of the Graduate College, University of Iowa; (9) Ruth Deacon, Dean of the College of Home Economics, Iowa State University; (10) Charles Mason, Associate Dean for Administration in the Graduate College, University of Iowa; (11) William Stwalley, Director of the Iowa Laser Facility and Professor of Chemistry and Physics, University of Iowa; (12) Wayne Anderson, Head of the Department of Earth Science and Professor of Geology, University of Northern Iowa.




Molecular Biology Building
Iowa State University
HLM Hansen Lind Meyer

Appendix 6.3

IOWA STATE UNIVERSITY
Art on Campus
UNIVERSITY MUSEUMS AFFILIATE

Molecular Biology Building

Title *The G-Nome Project*

Artist *Andrew Leicester*

Location
Molecular Biology Building
Materials
ceramic figures and
porcelain tile mosaic
Date
1992
Ceramic Sculptors
David Dahlquist and
Donovan Palmquist

G-Nome

About the Project

"In modern society we expect instant understanding...like watching television where everything is laid out before us and problems are resolved by the end of the half-hour. My art is not instantly understandable, nor is it meant to be taken lightly. Good art tends to raise questions, and it is important for artists to focus attention on the debatable. Otherwise, you get 'safe' art which serves only the prevailing popular theory." **~Andrew Leicester, 1992**

The G-Nome Project fully integrates art and architecture in the Molecular Biology Building. Since the artist, Andrew Leicester, was selected at the start of the project, he was able to work with the architectural firm Hansen Lind Meyer, Inc. to incorporate the art into the building's design. As a result, Iowa State University has gained a striking example of the successful merging of art and architecture, as well as a building rich in meaning and function.

When Andrew Leicester was commissioned by Iowa State University to create public art for the Molecular Biology Building, he began to research the kinds of activities that would take place there. He found information at conferences, by attending lectures, by reading books, and through conversations. He kept a sketchbook of ideas and drawings on the subject. It became clear to him that the most debated area of current investigation in the field of molecular biology is transgenetic animal research. Both the academic community and the public are expressing their opinions. Philosophers, sociologists, animal scientists, and economists are among the many people who are discussing the potential legal and economic implications of genetic research. How research should be regulated and what ethics should govern decisions are all important issues.

Made possible by the Iowa Art in State Buildings Program.

About the Art

Leicester discovered that while genetic engineering holds the promise of finding ways to prevent diseases, it also holds the potential for exploitation or accident. Even before genetics was understood scientifically, people feared the combination of species. It was thought that dragons and monsters could be the result. The sculptures and mosaics of Andrew Leicester's *G-Nome Project* ask the viewer to prepare for the future. It is our responsibility to think seriously about the ethical issues surrounding the technological frontier of genetic research.

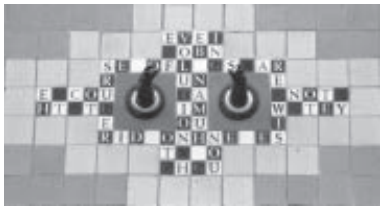
The *G-Nomes* are the twelve-foot tall terra-cotta sculptures that stand atop each corner of the Molecular Biology Building. In each hand the figures hold X and Y chromosome rods. The stylized black and white coats worn by the *G-Nomes* are symbolic references to the black suits worn by business people and the white lab coats worn by scientists. Together, these two professions will lead the molecular biology program at Iowa State University. The black and white squares also bring to mind crossword puzzles and the challenge of solving games. In this building, molecular biologists are trying to solve the genetic code of life. The symbolic black and white checks are repeated throughout much of the art.

G-Nome

G-Nome

The *G-Nome* figures may also be interpreted as "sacred guardians" of the Molecular Biology Building. Running up each side of the building beneath the *G-Nomes* is a twining pattern of ceramic tiles that represents strands of replicating DNA. Wrapped around each corner of the building, these strands symbolically hold the secrets of life that are being discovered inside. They also symbolize the fact that DNA strands contain the secret of life within themselves.

Leicester's title, *The G-Nome Project*, is full of meaning. It is a play on two relevant words: gnome and genome. The word “gnome” can mean a dwarf-like creature that usually guards precious treasure, or it can mean a terse saying. “Genome” is a scientific term for a complete set of chromosomes. This title also makes reference to the United States government's multi-billion dollar undertaking to map and decipher all the human genes -- *The Genome Project*. For additional information on *The Genome Project*, visit the following web site: http://www.ornl.gov/hgmis/.



Warning-Biohazard

Above the north entrance hangs a single terra-cotta relief called *Warning-Biohazard*. Two arms reach out from a design of jumbled letters on black and white tiles. When deciphered, the letters read: "HUMAN BEINGS ARE NOT YET WISE ENOUGH TO DIRECT THE COURSE OF EVOLUTION." This is a quote from Robert Sinsheimer, a noted scientist in molecular biology. The two outstretched hands look like the black contamination gloves built into the sides of controlled experimental chambers.These gloves, however, reach out from the building into the environment as if to use us and our surroundings as their experimental chamber.

Appendix 6.3

Over the south entrance are four reliefs titled *Hybrids*. Surrounding these cross-bred figures are tiles containing the letters A, G, C, and T. These represent the four basic building blocks of DNA. The relief centered over the entrance contains three images. The central one is the mythological sphinx. On either side of the sphinx is a box and a horn. These represent the two possible outcomes of molecular research: an open Pandora's box of evil or a cornucopia of good.

***Hybrids** (detail)*

***Gene Pool** (detail)*

Leicester designed three ceramic mosaics on the first floor of the building. The largest fills most of the atrium floor space and is titled *Gene Pool*. It is the image of a bacterium in the act of releasing strands of DNA. Scientifically speaking, a gene pool is a collection of genes in an interbreeding population. When this mosaic "pool" is viewed from above, it actually looks like a swimming pool, and plays on the double meaning.

The entrance vestibule contains the mosaic called *Conception is Capitalization*. This work presents a complete set of scattered human chromosomes as seen under a microscope. Encasing these chromosomes is a circle of dots that represent the petri dishes that are used for growing cells in culture.

The third mosaic floor is located in the auditorium lobby. This work, titled *Novel Agents*, derives its imagery from the phylogenetic tree and the fruit tree of the Garden of Eden. The phylogenetic tree maps out the evolutionary development of all animals and plants. The two symbols at the base of the tree represent a scorpion and a tarantula. Combined with the snake wrapped around the tree trunk, these poisonous creatures represent the possible dangers of tasting the fruit from this genetic tree. Above the tree flies a "super-genetic" creature, the dragon.

***Shotgun Method** (detail)*

Shotgun Method is the title of the 24 terra-cotta medallions that hang from the walls of the atrium. On these medallions, Leicester put ancient mythical creatures and new creatures made up from their combined body parts. The top medallions are hybrid creatures from medieval mythology. The middle row shows the random distribution of these creatures' individual body parts. The bottom row consists of new hybrids created from the parts found in the medallion directly above. These new creatures are accompanied by hypothetical genetic codes that Leicester invented by giving each body part a number.

Forbidden Fruit

At the base of the atrium staircase stands the sculpture *Forbidden Fruit*. This female figure recalls the pose and symbolism of ancient goddesses. Many of the goddess figures that have been excavated hold snakes in their outstretched arms. Snakes symbolize the powers of regeneration since they are "reborn" by shedding their skin. Instead of holding snakes in each hand, however, Leicester's sculpture holds strands of DNA that she has just split apart. In a sense, she is giving birth, since DNA holds the key of life and reproduces by splitting. This goddess is wearing a metallic contamination suit similar to those used in some scientific experiments. Her brain is exposed through the top of the helmet and from these roots the phylogenetic tree extends its branches.

Additional Information on the Artist

Visit Andrew Leicester's web site at www.andrewleicester.com.
Armstrong, Diane. "Cobumora - Myth and Magic Merge at W.S.U." *Modern Veterinary Practice*, January 1985.
Cohen, Ronny H. "Reviews, New York, Art on the Beach." *Artforum*, October 1980.
Doss, Erika. "Andrew Leicester's *Cobumora*." *Landscape Architecture*, Jan/Feb 1986.
Doss, Erika. "Andrew Leicester's Mining Memorials." *Arts Magazine*, January 1987.
Morganthau, Tom. "Get Rid of that Eyesore." *Newsweek*, August 17, 1987.
Rockcastle, Garth. "Art as Architecture." *Progressive Architecture*, October 1984.

Andrew Leicester's public art commissions include:

Central Area Surface Restoration Art Project, 1997, four downtown intersections across the Central Artery/Tunnel Project to the Waterfront, Boston, MA

Platonic Figure, 2001, University of Minnesota Institute of Technology, Department of Mechanical Engineering, Saint Paul, MN

Minnesota Profiles, 1995, Courtyard and Garden, Minnesota History Center, St. Paul, MN

Zanja Madre, 1992, Watergarden and Arcade, 801 Figueroa St. , Los Angeles, CA

Cincinnati Gateway, 1988, Entrance to Bicentennial Park, Cincinnati, OH

THE G-NOME PROJECT

Four Roof Figures: *G-Nomes*	**U91.71a-h**
South Entrance: *Hybrids*	**U91.72abcd**
North Entrance: *Warning-Biohazard*	**U91.73**
Atrium Medallions: *Shotgun Method*	**U91.74a-x**
Atrium Figure on Podium: *Forbidden Fruit*	**U91.75**
Atrium Floor Mosaic: *Gene Pool*	**U91.76**
Entrance Vestibule Mosaic: *Conception is Capitalization*	**U91.77**
Auditorium Lobby Mosaic: *Novel Agents*	**U91.78**

Additional information on *The G-Nome Project*, other Art on Campus information sheets, and Art on Campus maps are available at the University Museums office - 290 Scheman Building (2nd floor), 515/294-3342, or visit us online at www.museums.iastate.edu.

This information sheet is intended to be used in addition to viewing the Art on Campus Collection. At no time should this sheet be used as a substitute for experiencing the art in person.

Appendix 6.4

PRESENTED WITH GRATITUDE TO

Peter J. Lelonek

FOR HIS SIGNIFICANT CONTRIBUTION IN MAKING THE
IOWA STATE UNIVERSITY MOLECULAR BIOLOGY BUILDING A REALITY

MARCH 5, 1992

Presentation by Walter R. Fehr at the recognition dinner for the Molecular Biology Building held at 7:30 p.m. at the Holiday Inn Gateway Center on March 5, 1992.

Good evening ladies and gentlemen. We are pleased that you have joined us as we recognize those persons who have made the Molecular Biology Building a reality. The first item on the program is dinner. Enjoy.

AFTER DINNER

I am Walter Fehr, Director of Biotechnology at Iowa State University. I stand before you tonight in my last official act as chair of the planning committee for the Molecular Biology Building. Before we recognize the persons who made it possible through their hard work and dedication to celebrate our new building, I want to introduce some persons who are not being formally recognized, but who are important in the life of our university.

First, I want to introduce persons who have been and or are currently vital to the success of the biotechnology program at Iowa State. The Biotechnology Council was formed in 1984 by Daniel Zaffarano, Vice President for Research, to initiate a university-wide program in biotechnology research, teaching, and outreach. Since we have the father of the biotechnology program with us, I would like Dan to rise and remain standing while I introduce the remainder of his children. I would appreciate it if the persons whose names I call would stand and remain standing with Dan until all of the biotechers have been introduced. I think I am in deep trouble by calling the next person one of Dan's biotech children, but here goes anyway. When Dr. Zaffarano retired, we were most fortunate that the Associate Vice President Norman Jacobson assumed the position of Vice President for Research. A year later, Norman retired and was replaced by Patricia Swan. A year later, Dr. Swan became the Interim Provost. Serving in her stead on an interim basis are John Dobson and Wallace Sanders. Now I want you the meet my faculty colleagues who faithfully meet each week to provide our university and the people of Iowa with one of the finest biotechnology programs in the country. I know some of them could not be here tonight, but I want you to know who they are. From the College of Agriculture, Richard Hall, Arnel Hallauer, and Susan Lamont; from the College of Engineering, Peter Reilly; from the College of Family and Consumer Sciences, Ken Prusa; from the College of Liberal Arts and Sciences, Therese Cotton and Richard Honzatko; and from the College of Veterinary Medicine Prem Paul and Ricardo Rosenbusch. I would like you to meet the deans of the five colleges represented on the Biotechnology Council, some of whom could not be here tonight: David Topel from the College of Agriculture, David Kao from the College of Engineering, Beverly Crabtree from the College of Family and Consumer Sciences, David Glenn-Lewin from the College of Liberal Arts and Sciences, and Richard Ross from the College of Veterinary Medicine. Ladies and gentlemen, please recognize these important people.

In 1986, our former President W. Robert Parks formed an Industry Advisory Board for Agricultural Biotechnology to assist the university in building a world-class biotechnology program. I will tell you about some of the activities of the board later, but now I would

like you to meet the current members who are with us tonight. Please remain standing as I call your names. Charlie Lewis and Jack Garbutt of the Grain Processing Corporation in Muscatine, Ted Crosbie and Michael Martin of ICI Seeds, Inc., in Coon Rapids and Slater, Chris Nelson of Kemin Industries in Des Moines, Nick Frey of Pioneer Hi-Bred International in Des Moines, Leroy Hanson of Triple F in Des Moines, and Bruce Hunter of CIBA GEIGY-Funk seeds in Greensboro, North Carolina. Please extend a warm welcome to these outstanding friends of Iowa State.

We have some other important friends of Iowa State here this evening that I would like to ask Murray Blackwelder, President of the Iowa State University Foundation, to introduce.

Thank you Murray and guests.

We are pleased that colleagues from our sister institutions have joined us for this important celebration. From the University of Northern Iowa, Dean Gerald Intemann, and from the University of Iowa, the Interim Vice President for Research, Derek Willard. Thank you very much for coming.

The success of today's activities are due to the hard work and diligence of many Iowa State faculty and staff. I would like you to meet them. Would the persons rise and remain standing. Barbara Mack, Executive Assistant to the President; Cherryl Jensen, Director of the Office of University Relations and her staff members Diana Pounds, Steve Jones, and John Anderson; the manager of the Molecular Biology Building, Peter Lelonek; Duane Enger, Chair of the Department of Zoology and Genetics; Bernard White, Chair of the Department of Biochemistry and Biophysics; and Steven Price, Interim Director of the Office of Intellectual Property and Technology Transfer. Finally, the members of the staff of the Office of Biotechnology, to whom I owe a big debt of gratitude for their exceptional effort in preparing for this event and their diligence throughout the year, Marilyn Peterson, Sheila Lacy, Yolanda Martin, Priscilla Matt, Alan Anderson, and Glenda Webber. Please thank all of these people for their excellent work.

The persons we are now going to honor will each receive a plaque as a small token of appreciation. The plaques were designed and donated by Hansen Lind Meyer. I would like to have Robert Novak of HLM stand and be recognized for his work in designing and producing the plaques, and I would like Tom Pearson to stand and accept our thanks for this generous donation by HLM. Our calligrapher was Missi Paul, who joins us this evening as the guest of her husband, Biotechnology Council Member Prem Paul. And at the risk of getting into a lot of trouble when I get home tonight, I would like you to meet the two people who, at no cost to the taxpayers of Iowa, assembled the plaques, my wife Elinor and my mother, who came all the way from northern Minnesota to celebrate this special occasion with our family.

I would like to ask President Jischke to come forward to present the plaques to our honorees. I could say a great deal about each of these individuals, but if I did, you would be here until the early hours of tomorrow morning. However, I would like to tell you a brief history of the

building as a way of describing the contributions of our honorees. The honorees are going to have to stay on their toes during this part of the program because when you hear your name, I would like you to come forward, receive your plaque from President Jischke, and return to your seat. If you don't hear your name and expect to receive a plaque, I am in trouble. If you miss your name and don't come forward, you are in trouble. Some of the honorees could not be here tonight, but I will present their names to you for recognition. Please hold your applause until all of the plaques have been awarded.

The support needed to make the Molecular Biology Building a reality began to develop with the formation of the biotechnology program at Iowa State University in 1984. The idea for the biotechnology program began in a swimming pool in Brownsville, Texas, during our university spring break and became a reality with the formation of the Biotechnology Council by Dan Zaffarano. During 1984 and 1985, the Council laid the groundwork for a world class biotechnology program at Iowa State. But the vision of the Council could not become a reality without the financial support of the State of Iowa. In the fall of 1985, the vision of the Council was shared with a unique group of industry leaders. They responded by carrying the vision of a world class biotechnology program to Governor Branstad and the leaders of the Iowa legislature, including the present majority leader of the Senate, Bill Hutchins. Our political leadership responded by providing the university with 18 million dollars for a 4-year program. And as if that wasn't enough, the same industry leaders worked hard in the next legislative session to secure funding for the building. I would like you to meet the people for whom the biotechnology program and the Molecular Biology Building are truly theirs. George Barr of Cenex/Land O'Lakes, John Chrystal, formerly of Bankers Trust, Ted Crosbie of ICI/Garst, Robert Erwin of Biosource Genetics, Nick Frey of Pioneer Hi-Bred International, Leroy Hanson of Triple-F, Charlie Lewis of Grain Processing, and Chris Nelson of Kemin Industries. From this small band of industry leaders grew the Industry Advisory Board for Agricultural Biotechnology, a group of outstanding industry leaders from 13 companies who even today are actively seeing support to expand the program in biotechnology that they began. We are extremely grateful for their support of the program.

There were other key people who also wanted Iowa State to develop excellence in biotechnology and who stepped forward to join the effort in securing the funds needed to build a facility that would significantly increase the research, teaching and outreach program of the university. First, there were the leaders of the university administration who took the concept of the building to the Board of Regents, our former president Gordon Eaton, our Vice Presidents Warren Madden and Daniel Zaffarano, our Associate Vice President Norman Jacobson, our former Legislative Liaison, Reid Crawford, and our Head of Space and Schedules, John Pace. Second, there were the members of the Board of Regents who not only wholeheartedly endorsed the building concept, but who were actively involved in reviewing and approving the design: Regents Margaret Anderson, Charles Duchen, John Fitzgibbon, John Greig, Percy Gene Harris, John McDonald, June Murphy, Marvin Pomerantz, James Tyler, Mary Williams, Jacklyn Van Ekeren, and Bass Van Gilst. The staff of the Board of Regents, led by R. Wayne Richey, gave excellent support throughout the presentation of the building to the governor and the legislators, and during the design and development phases.

Appendix 6.5

We are indebted to all of you for making the Molecular Biology Building a reality.

Even before funds for the building were approved, the university was told to begin the selection of an architect and a building manager. We were told to put the project on a fast track, which meant instead of appropriating funds to plan the building one year, followed by a request for funds to build the facility the next year, the Board of Regents was going to ask for the planning and construction funds at the same time. Needless to say, the planning activities went from zero to 100 miles per hour in record time. The first planning meeting took place in December 1986 and the Iowa State planning and development contingent grew rapidly. These people would devote a significant part of their time to designing and building the best possible facility that we could for Iowa. Alan Atherly, Conrad Berhow, Charles Dekovic, Vern Faber, Donald Graves, Joan Hopper, Cindy Howe, Peter Lelonek, Norman Jacobson, Gary Reynolds, James Roth, Lynn Seiler, John Sluis, Ev Swagert, Carol Swenson, Bernard White, and William Whitman. What a team! They represented the best intercollegiate team that we could assemble. They were asked to design and construct a building that would serve the university and the people of Iowa for many years to come. And they did it.

One of the reasons they did it so well was because of the outstanding architectural and construction management firms that were selected for the project. We wanted the best firms in the world for this project, and we got them. And they were from Iowa. Is this heaven or what? Our architectural firm was Hansen Lind Meyer. The project director was Tom Pearson. I would like to invite Tom to come forward to make some remarks and to introduce his honorees and guests. (At this point, President Jischke should sit down until Tom is ready to honor his people, who are the project architects Steve Rohrbach and Robert Carlson, the project designer Robert Novak; from Stanley Consultants, Herbert Ohrt, Vice President, and Wayne Brugger, Design Manager; and Research Facilities Design, represented by Malcolm Barksdale and Rick Heinz).

Gentlemen, thank you for designing one of the finest molecular biology buildings in the world!

You can design the finest building in the world, but it only functions the way it is supposed to if it is built right. We were extremely fortunate to have had as the construction manager Story Construction Co. of Ames. Let me assure you that the president of the company, Norman Riis, was anything but a figurehead. He was in the trenches with us trying to get the most building for the money. And he and his staff did an exceptional job. Norman, would you please come forward to share some remarks with us and to recognize your honorees? (At this point, President Jischke should sit down until Norman is ready to honor his people, who are Charles Bell, Construction Manager, and James Voss, Project Engineer.)

Gentlemen, you did a wonderful job on this project and we are grateful.

One of the most intriguing aspects of the building for the general public is the art. The art committee was led by Lynette Pohlman, Director of our University Museums, and Michael Underhill, formerly in our College of Design. They and their committee selected an excellent artist, Andrew Leicester. Andrew did an excellent job of working closely and effectively with all the other persons who were part of the building design and construction. I would like Andrew to come forward and share some remarks with us. (President should be seated until Andrew is done.)

When we were securing funds for the building, the university was told not to come back later and ask for equipment as a separate appropriation. That left us with a serious dilemma. How do we build as large a facility as we need, and yet equip it properly? Hon Industries of Muscatine came to our rescue in a most generous manner. The plaque that you saw at the dedication ceremony will be attached to the wall outside the Hon Conference Room. Mr. Howe, would you please come forward and accept a plaque for Hon Industries that you can take home with you. I hope you will display it as proudly as I do the toy semi-trailer truck from Hon Industries that is in my office. Mr. Howe, we are indebted to you and Hon Industries for providing us with outstanding furniture for the building, and I thank you for my toy truck.

The final plaque this evening is for the Kresge Foundation in Troy, Michigan. Through a $500,000 gift to the university, we were able to secure two major pieces of equipment that are effectively serving the entire university. I will be sure the Kresge Foundation receives the plaque and our gratitude.

Everyone we have honored tonight should rightfully consider the Molecular Biology Building as their building. It is an accomplishment that you should always think of with tremendous pride. Thank you for giving it your best.

I would like to ask all of the honorees to stand and receive our thanks for an excellent job. Be proud.

To close the evening, I would like to call on President Jischke for the final remarks. After his remarks, I welcome you to stay and celebrate as long as you can stand it. President Jischke.

(The President's remarks)

Appendix 9.1

NEW IOWA STATE UNIVERSITY FACULTY IN BIOTECHNOLOGY

1987	**Department**	**College**
Thomas Ingebritsen	Zoology and Genetics	Liberal Arts and Sciences
Michael Lee	Agronomy	Agriculture
Chris Minion	VMRI	Veterinary Medicine
Alan Myers	Biochemistry/Biophysics	Liberal Arts and Sciences
Robert Thornburg	Biochemistry/Biophysics	Agriculture
Donald Reynolds	VMRI	Veterinary Medicine
1988		
David Hannapel	Horticulture	Agriculture
Eric Henderson	Zoology and Genetics	Liberal Arts and Sciences
Suzanne Hendrich	Food Science & Human Nutrition	Family & Consumer Sciences
Agustin Kintanar	Biochemistry/Biophysics	Liberal Arts and Sciences
Drena Larson	Zoology and Genetics	Liberal Arts and Sciences
Basil Nikolau	Biochemistry/Biophysics	Agriculture
Zivko Nikolov	Food Science & Human Nutrition	Agriculture
Jacob Petrich	Chemistry	Liberal Arts and Sciences
Patrick Schnable	Agronomy	Agriculture
1989		
Susan Carpenter	MIPM	Veterinary Medicine
James Colbert	Botany	Liberal Arts and Sciences
Jorgen Johansen	Zoology and Genetics	Liberal Arts and Sciences
W. Allen Miller	Plant Pathology	Agriculture
1990		
Curtis Youngs	Animal Science	Agriculture
Therese Cotton	Chemistry	Liberal Arts and Sciences
Michael McCloskey	Zoology and Genetics	Liberal Arts and Sciences
1991		
Eve Wurtele	Botany	Liberal Arts and Sciences
Steven Rodermel	Botany	Liberal Arts and Sciences
Donald Sakaguchi	Zoology and Genetics	Liberal Arts and Sciences
Robert Wallace	Botany	Liberal Arts and Sciences
Monica Howard	Veterinary Pathology	Veterinary Medicine
Christopher Tuggle	Animal Science	Agriculture
1992		
Linda Ambrosio	Zoology and Genetics	Agriculture
Joan Cunnick	MIPM	Agriculture
Alan DiSpirito	MIPM	Agriculture
Douglas Lewis	Food Science & Human Nutrition	Family & Consumer Sciences
Wendy White	Food Science & Human Nutrition	Family & Consumer Sciences
Gary Lindberg	Animal Science	Agriculture
William Jenks	Chemistry	Liberal Arts and Sciences
Kristen Johansen	Zoology and Genetics	Liberal Arts and Sciences
Daniel Voytas	Zoology and Genetics	Agriculture
1993		
Gregory Phillips	MIPM	Agriculture
Janice Buss	Biochemistry/Biophysics	Liberal Arts and Sciences
1994		
Carole Heath	Chemical Engineering	Engineering
Cheng Lee	Chemistry	Liberal Arts and Sciences

1995		
Byrony Bonning	Entomology	Agriculture
Russell Jurenka	Entomology	Agriculture
1996		
Gwyn Beattie	MIPM	Agriculture
Philip Becraft	Zoology and Genetics	Agriculture
Thomas Baum	Plant Pathology	Agriculture
1997		
Harley Moon	Veterinary Medicine	Veterinary Medicine
David Oliver	Botany	Liberal Arts and Sciences
Mark Ackermann	Veterinary Pathology	Veterinary Medicine
Parag Chitnis	Biochemistry/Biophysics	Liberal Arts and Sciences
1998		
Amy Andreotti	Biochemistry/Biophysics	Liberal Arts and Sciences
Jo Anne Powell-Coffman	Zoology and Genetics	Agriculture
John Davies	Botany	Liberal Arts and Sciences
1999		
Jeffrey Beetham	Vet. Pathology and Entomology	Veterinary Medicine
Mark Hargrove	Biochemistry, Biophysics and Molecular Biology	Liberal Arts and Sciences
Frank Anderson Norris	Biochemistry,Biophysics, and Molecular Biology	Liberal Arts and Sciences
Volker Brendel	Zoology and Genetics	Agriculture
Kevin Schalinske	Food Science & Human Nutrition	Family & Consumer Sciences
James Reecy	Animal Science	Agriculture
Jacqueline Shanks	Chemical Engineering	Engineering
2000		
Anumantha Kanthasamy	Biomedical Sciences	Veterinary Medicine
Victor Lin	Chemistry	Liberal Arts and Sciences
Richard Martin	Biomedical Sciences	Veterinary Medicine
Gloria Culver	Biochemistry, Biophysics and Molecular Biology	Liberal Arts and Sciences
Douglas Jones	Veterinary Pathology	Veterinary Medicine
Mei Hong	Chemistry	Liberal Arts and Sciences
2001		
Daniel Armstrong	Chemistry	Liberal Arts and Sciences
Madan Bhattacharyya	Agronomy	Agriculture
Adam Bogdanove	Plant Pathology	Agriculture
Timothy Day	Biomedical Sciences	Veterinary Medicine
Unoh Kim	Biomedical Sciences	Veterinary Medicine
John Nason	Botany	Agriculture
Yeon-Kyun Shin	Biochemistry, Biophysics and Molecular Biology	Liberal Arts and Sciences
2002		
Ron Mittler	Botany	Liberal Arts and Sciences
Jesse Hostetter	Veterinary Pathology	Veterinary Medicine
Carolyn Komar	Animal Science	Agriculture
Heather Greenlee	Biomedical Sciences	Veterinary Medicine
Jitke Ourednik	Biomedical Sciences	Veterinary Medicine
Vaclav Ourednik	Biomedical Sciences	Veterinary Medicine
Chad Stahl	Animal Science	Agriculture

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2003		
Reuben Peters	Biochemistry, Biophysics and Molecular Biology	Liberal Arts and Sciences
Ramon Gonzalez	Chemical Engineering	Engineering
2004		
Ethan Badman	Chemistry	Liberal Arts and Sciences
Qijing Zhang	Veterinary Microbiology and Preventive Medicine	Veterinary Medicine
Clark Wolf	Bioethics	LAS, Agriculture, FMCS, ENGR, PSI, Office of Biotechnology
Gustavo MacIntosh	Biochemistry and Biophysics	Liberal Arts and Sciences
Lisa Nolan	Veterinary Microbiology and Preventive Medicine	Veterinary Medicine
Eric Volbrecht	Genetics, Development and Cell Biology	Agriculture
Brett Sponseller	Veterinary Microbiology and Preventive Medicine/Veterinary Clinical Sciences	Veterinary Medicine
2005		
Anne Bronikowski	Ecology, Evolution, and Organismal Biology	Liberal Arts and Sciences
Matthew Ellinwood	Animal Science	Agriculture
Edward Yu	Physics	Liberal Arts and Sciences
Dennis Lavrov	Ecology, Evolution, and Organismal Biology	Liberal Arts and Sciences
Nicole Valenzuela	Ecology, Evolution, and Organismal Biology	Liberal Arts and Sciences
Clark Coffman	Genetics, Development and Cell Biology	Agriculture/LAS
Yanhai Yin	Genetics, Development and Cell Biology	Liberal Arts and Sciences
Thomas Bobik	Biochemistry, Biophysics, and Molecular Biology	Liberal Arts and Sciences & Agriculture (split position)
Diane Moody	Animal Science	Agriculture
Byron Brehm-Stecher	Food Science & Human Nutrition	Family & Consumer Sciences
Christine Petersen	Veterinary Pathology	Veterinary Medicine
2006		
Michael Shogren-Knaak	Biochemistry, Biophysics and Molecular Biology	Liberal Arts and Sciences
Jeffrey Essner	Genetics, Development and Cell Biology	Liberal Arts and Sciences
Lyric Bartholomay	Entomology	Agriculture
Michael Spurlock	Food Science & Human Nutrition and Animal Science	Human Sciences/Agriculture
Jeanne Serb	Ecology, Evolution, and Organismal Biology/CIAG	Liberal Arts and Sciences/ Agriculture (split position)
Vicki Wilke	Veterinary Clinical Sciences	Veterinary Medicine
Brad Blitvich	Veterinary Microbiology and Preventive Medicine	Veterinary Medicine
Arthi Kanthasamy	Biomedical Sciences	Veterinary Medicine
Cathy Miller	Veterinary Microbiology and Preventive Medicine	Veterinary Medicine
Michael Kimber	Biomedical Sciences	Veterinary Medicine
2007		
Bryan Bellaire	Veterinary Microbiology and Preventive Medicine	Veterinary Medicine
Peng Liu	Statistics	Liberal Arts and Sciences
Julie Blanchong	Natural Resource Ecology and Management	College of Agriculture
Bing Yang	Genetics, Development and Cell Biology	Liberal Arts and Sciences

2008		
Guru Rao	Biochemistry, Biology, and Molecular Biology	Liberal Arts and Sciences
Thomas Lübberstedt	Agronomy	College of Agriculture
Steve Carlson	Biomedical Sciences	Veterinary Medicine
Sinisa Grozdanic	Veterinary Clinical Sciences	Veterinary Medicine
Ravinda Singh	Biomedical Sciences	Veterinary Medicine
Gaya Amarsinghe	Biochemistry, Biology, and Molecular Biology	Liberal Arts and Sciences
2009		
Laura Jarboe	Chemical & Biological Engineering	Engineering
Matthew Rowling	Food Science & Human Nutrition	Human Sciences
Olga Zabotina	Biochemistry, Biology, and Molecular Biology	Agriculture
Nicholas Gabler	Animal Science	Agriculture
Ian Schneider	Chemical & Biological Engineering	Engineering
Peter Nara	Biomedical Sciences	Veterinary Medicine
Joshua Selsby	Animal Science	Agriculture
Jason Ross	Animal Science	Agriculture
2010		
Scott Nelson*	Biochemistry, Biology, and Molecular Biology	Liberal Arts and Sciences

*Most recent faculty member to receive startup funds in FY2010 (July 1, 2009)

Codes:
VMRI--Veterinary Medical Research Institute
MIPM--Microbiology, Immunology and Preventive Medicine

Appendix 10.1

Draft for Review by the
Biotechnology Council and
the Vice Provost for Research

OPERATING POLICIES FOR THE BIOTECHNOLOGY INSTRUMENTATION FACILITIES AT IOWA STATE UNIVERSITY
Developed by the Biotechnology Council and
Approved by the Vice Provost for Research and Advanced Studies
April 1992

The operating policies described in this document were developed for the effective operation of the Biotechnology Instrumentation Facilities at Iowa State University. The policies are intended to provide uniform management procedures for all current and future facilities.

All Biotechnology Instrumentation Facilities that receive major support from the Biotechnology Council will report to it. Recommendations of the Biotechnology Council for operation of the facilities are made to the Vice Provost for Research and Advanced Studies for final approval.

Director of Biotechnology

The Director is responsible for implementing the policies of the Biotechnology Council. The individual will serve as the departmental executive officer for personnel hired by the Biotechnology Council on 102 accounts, for approval of purchases from 102 accounts, and other relevant matters. If a facility is concerned about the action of the Director, they are encouraged to present the concerns to the Biotechnology Council at its weekly meeting.

Professor-in-Charge

Each facility will have a professor-in-charge (PIC) who is appointed by the Council and Vice Provost. The PIC is responsible to the Biotechnology Council. The PIC will not receive any salary from a 102, 202, or other account directly associated with a facility, without prior written approval of the Council and Vice Provost.

Personnel

Persons who are hired by the Council to operate the facilities are employees of the Office of Biotechnology and should consider it their departmental affiliation. They will be paid entirely from 102 accounts established by the Office for each facility. Funds from the 202 accounts may not be used to pay for services of any employee of the Office without prior written approval of the Council and Vice Provost.

The PIC will be the immediate supervisor of all personnel employed by the Office of Biotechnology, unless one of the personnel is designated by the Council as the supervisor. If a supervisor is hired for a facility, the PIC will be her/his immediate supervisor. The Director of Biotechnology will serve as the departmental executive officer of the personnel for approval of vacation and sick leave requests, travel authorizations, employee evaluations, and other personnel matters. All requests for salary adjustments, including promotions, will be made in writing by the

employee to the PIC. The PIC will forward the request with her/his recommendation to the Director of Biotechnology. The Director will present the request to the Council, which will review the request and recommend appropriate action.

For annual salary adjustments, the Director will request a recommendation from the PIC for each employee in the facility. The Director will prepare a summary of the requests for all employees and present it to the Council. The Council will review the requests and develop a recommendation for the Vice Provost.

User Committee

Each facility will have a User Committee. The committee will be made up of five to seven faculty members who regularly utilize the research services of the facility. The majority of the voting members will be from outside the department in which the facility resides. The chair will be elected by the committee and will not be from the department in which the facility resides. The PIC, personnel of the Office of Biotechnology in the facility, and one member of the Biotechnology Council will serve as ex officio members without vote. The council member on the committee will be appointed by the Council.

The User Committee will meet at least once a semester. Minutes of the meeting will be recorded and distributed promptly to

the Office of Biotechnology and the DEO of the department in which the facility resides.

The User Committee will advise the Biotechnology Council on fees that should be charged for services of the facility; purchase, maintenance, operation of equipment, and other relevant activities. To maintain an appropriate fee structure, the committee will review at least once a semester the income and expenditures of the 202 account.

Instrumentation Facilities Committee

The personnel of the instrumentation facilities and the PICs will constitute the Instrumentation Facilities Committee. The chair of the committee will be the Director of Biotechnology. The purpose of the committee is to facilitate planning and communication among the facilities. The committee will advise the Council on matters relevant to operations of the facilities.

The committee will meet at least once a semester. Personnel of the Office of Biotechnology are expected to attend the meeting and contribute in a positive manner to the discussion. The Biotechnology Council and the committee will meet jointly during the fall semester to review operating policy and other relevant matters.

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The committee as a whole will be asked by the Council to review any requests for equipment from any facility that are in excess of $10,000. The input of the committee may be obtained by written communication or at a scheduled meeting. If one facility opposes the purchase of equipment by another facility, the disagreement will be brought to the Council.

102 Accounts

A 102 account will be established for each facility, based on the budget approved annually by the Council and Vice Provost. The funds provided to a 102 account are not considered a block budget. Expenditures must be made in accordance with the budget items approved by the Council. Any deviations from the approved budget must be reviewed and approved by the Council. The 102 accounts are considered departmental accounts of the Office of Biotechnology and will have the designation of 102-47-2x-47-xxxx. All expenditures from the 102 accounts must be signed by the Director. For 102 expenditures, it is not necessary to have the signature of the departmental executive officer in which the facility resides.

For each expenditure from a 102 account, a purchase requisition should be completed, including a brief description of the reason for the purchase. When the requisition is forwarded to the Office of Biotechnology, a copy of the budget approved by the Council should be attached with a clear identification of the budget line to which the expenditure pertains. If the purchase

represents a deviation from the approved budget, the reason for the change should be indicated.

Purchases that are consistent with the approved budget will be signed by the Director and forwarded to the appropriate office. If the purchase is a deviation from the approved budget, the Director will request a recommendation from the Council. The Council may request additional information from the PIC.

All expenditures from 102 accounts must be completed before June 30 of each fiscal year. Funds remaining in any 102 account will be disbursed to other Council programs. Overexpenditures in a 102 account will be deducted from the funds available to the facility during the next fiscal year.

202 Accounts

Each facility will have a 202 account for the receipt and expenditure of user fees. To expedite the frequent receipt and expenditure of funds, the 202 account will be managed by the department in which the facility resides. Funds in a 202 account may only be used for operation of the facility. The funds must not be used for other departmental activities. Expenditures from the 202 account will be approved by the departmental executive officer and follow standard university-approved budgetary practices. Overexpenditures from a 202 account will be the responsibility of the department in which the facility resides.

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Persons hired with 202 funds will be considered employees of the department in which the facility resides.

Any major equipment purchases from the 202 account in excess of $10,000 must be reviewed and approved by the Biotechnology Council and the Vice Provost.

The User Committee for each facility will be expected to review the income and expenditures from the 202 account at its regular meetings. If the fee structure of a facility is generating excessive income, the fees for ISU users could be reduced. The Biotechnology Council will require a summary report of 202 expenditures as part of the annual report of the facility. Justification for major expenses from the 202 account should be included. A copy of the monthly departmental statements for each 202 account should be sent to the Office of Biotechnology for its records.

Annual Reports

Each facility will prepare an annual report for the Biotechnology Council that is due in February. The report will include:

(a) persons who have utilized the facility during the year,

(b) any publications that resulted from research for which the instrumentation facility was cited as a contributor,

(c) industry participants,

(d) grant proposals that were submitted during the year to obtain equipment and other support for the instrumentation facility, and the status of the proposals,

(e) status of the facility budget as of December 31,

(f) a request for support from the Council for the next fiscal year,

(g) the current fee structure and the fee structure for the next fiscal year,

(h) current user committee and committee as of July 1.

The budget for next year normally should include only the cost of maintaining current equipment and support for current personnel. Any additional items that would be desirable for the facility should be included and will be reviewed by the Council.

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The PIC, chair of the User Committee, and other appropriate persons for each facility will meet with the Council beginning in March to discuss their budget request for the next fiscal year and any other matters of importance. The PIC will be asked by the Office of Biotechnology for the amount of time preferred for the meeting with the Council.

After the budget for the facilities from 102 accounts have been approved by the Council and Vice Provost, the Office of Biotechnology will document in writing for each facility the items approved and not approved. A copy of the budget memorandum should be attached to purchase requisitions sent to the Office of Biotechnology with a clear indication of the budget line to which the expenditure pertains.

Equipment Grants

The facilities are strongly encouraged to seek outside grants, particularly for equipment purchases. All equipment grants that request university matching funds from any source should be brought to the Council. This will permit the Council to understand the administrative units of the university that are contributing to a facility.

Introduction to Molecular Biology Techniques Courses

Fall 2008

Workshop	Instructor	Facility
Transformation of *E. coli*	Gary Polking	DNA
Isolation and quantification of DNA	Gary Polking	DNA
Polymerase chain reaction (PCR)	Gary Polking	DNA
Automated DNA sequencing and sequence analysis	Mike Baker, Jon Mlocek	DNA
Genotyping	Mike Baker	DNA
Introduction to Proteomics	Joel Nott	Protein
Isoelectric focusing, SDS-PAGE and 2-D electrophoresis	Joel Nott	Protein
Western blotting, detection, amino acid sequencing and internal amino acid sequencing	Joel Nott	Protein
Gel scanning and analysis, search of protein databases	Joel Nott	Protein
Evaluation of data	Joel Nott	Protein
Monoclonal antibody development and use	Paul Kapke	Hybridoma
Microscopic tools and techniques for biotechnology and life science	Jack Horner, Tracey Pepper	Microscopy and NanoImaging
Immunophenotyping	Shawn Rigby	Flow Cytometry
ELISA assays	Paul Kapke	Hybridoma
Image analysis	Margie Carter	Image Analysis

Spring 2009

Workshop	Instructor	Facility
Transformation of *E. coli*	Gary Polking	DNA
Isolation and quantification of DNA	Gary Polking,	DNA
Polymerase chain reaction (PCR)	Gary Polking	DNA
Automated DNA sequencing and sequence analysis	Mike Baker, Jon Mlocek	DNA
Genotyping	Mike Baker	DNA
Fermentation	John Strohl	Fermentation
Protein isolation and purification	Joel Nott	Protein
Nuclear magnetic resonance	Bruce Fulton	NMR
SDS-PAGE and blotting for amino acid analysis	Joel Nott	Protein
Confocal microscopy and laser microdissection	Margie Carter	Confocal Microscopy
Monoclonal antibody development and use	Paul Kapke	Hybridoma
Immunophenotyping	Shawn Rigby	Flow Cytometry
ELISA assays	Paul Kapke	Hybridoma
Microscopic tools and techniques for biotechnology	Jack Horner, Tracey Pepper	Microscopy and NanoImaging
Image analysis	Margie Carter	Image Analysis
Plant transformation and transgenic plant analysis	Kan Wang and PTF team	Plant Transformation
Techniques in metabolomics	Ann Perera	Metabolomics

Summer 2009

Workshop	Instructor	Facility
Transformation of *E. coli*	Gary Polking	DNA
Isolation and quantification of DNA	Gary Polking	DNA
Polymerase chain reaction (PCR)	Gary Polking	DNA
Automated DNA sequencing and sequence analysis	Mike Baker, Mlocek	DNA
Genotyping	Mike Baker	DNA
Nuclear magnetic resonance	Bruce Fulton	NMR
Protein isolation and purification	Joel Nott	Protein
SDS-PAGE and blotting for amino acid analysis	Joel Nott	Protein
Monoclonal antibody development and use	Paul Kapke	Hybridoma
Immunophenotyping	Shawn Rigby	Flow Cytometry

Appendix 12.2

IOWA STATE UNIVERSITY

Biotechnology

Agricultural and Biosystems Engineering
Agricultural Business and Economics
Agricultural Education and Studies
Agronomy
Animal Ecology
Animal Science
Biochemistry, Biophysics, and Molecular Biology
Biology
Biomedical Sciences
Chemical and Biological Engineering
Chemistry
Civil, Construction, and Environmental Engineering
Computer Science
Electrical and Computer Engineering
Entomology
Food Science and Human Nutrition
Forestry
Genetics
Health and Human Performance
Horticulture
Mathematics
Microbiology
Philosophy and Religious Studies
Physics and Astronomy
Political Science
Statistics

Biotechnology discoveries are:

- improving human, animal, and plant health;
- increasing the availability of nutritious food products;
- reducing our reliance on chemical pesticides;
- expanding the variety of products produced by living organisms; and
- impacting our economy, legal system, and ethical standards.

Many kinds of careers involve biotechnology. Biotechnologists work in agriculture, human health sciences, industrial bioprocessing, criminal justice, and many other career areas. For this reason, Iowa State University does not have a major called biotechnology. Instead, you can select a major from more than 25 academic departments or programs and structure your degree program to prepare you for the biotechnology career of your choice.

Do you love adventure and discovery? Would you like to explore the unknown—map the uncharted inner space of chromosomes and genes? Do you want to help society define the legal, ethical, and moral boundaries of genetic research? If you have a pioneering spirit, then consider studying biotechnology, one of the world's most exciting frontiers.

Preparing for a biotechnology career

An Iowa State undergraduate degree with a biotechnology emphasis is a solid foundation on which to build a career. If you decide to enter the workplace after earning your Iowa State degree, you'll find that an emphasis in biotechnology attracts employers in industry, government, and public health. You might be part of a team researching and developing new and beneficial industrial products. You may help find a cure for a devastating disease. You could work to modify the genetic code of plants or animals to improve crop varieties and livestock breeds. You might work in a forensics laboratory to help solve crimes. Or you might provide the scientific or ethical expertise that government agencies and legislative bodies need to help them guide the direction of biotechnology research.

Selecting the best academic department for you

When you choose to prepare for a biotechnology-related career at Iowa State, you have many options. Iowa State University does not have a major called biotechnology because many different kinds of careers involve biotechnology. Instead, you will select a major within an academic department, and then structure your degree program to emphasize biotechnology. Your major is the specialized area in which you will apply your biotechnology training.

Working with the best faculty

More than 300 faculty members at Iowa State University are involved in some aspect of biotechnology teaching and research. Their academic homes are in the colleges of Agriculture, Engineering, Human Sciences, Liberal Arts and Sciences, or Veterinary Medicine.

In the classroom, Iowa State's biotechnology faculty provide quality teaching supported by the latest in instructional technology. You will learn from internationally recognized experts who are skilled in helping students like you achieve their academic goals. Many academic departments sponsor student clubs where you can enjoy academic, career, and social opportunities with other students and faculty who share your interests.

In the laboratory, you can obtain practical, hands-on experience to build your scientific expertise, increase your value to prospective employers, and help finance your education. Many biotechnology faculty welcome undergraduate students as members of their interdisciplinary research teams. Paid positions are available year-round.

Working in the best facilities

Iowa State's 235 general classrooms and 500 teaching laboratories are among the best in the world. The university's information technology services have permanently equipped more than 130 general classrooms to display output from computers, videos, laser discs, and document cameras, as well as traditional media. Computer labs and wireless networking are available to students throughout the campus. A distributed computing environment will provide you with electronic mail and other Internet services.

In addition to hands-on experience in well-equipped teaching laboratories, you can learn how to operate state-of-the-art scientific instruments in more than a dozen instrumentation facilities. You'll access the latest equipment available for research in cells, proteins, nucleic acids, fermentation, microscopy, image analysis, nuclear magnetic resonance, animal gene transfer, and plant transformation. Many of the instrumentation facilities that support biotechnology research offer free instruction to students.

Majors Related to Biotechnology

Making your career choice

Iowa State University departments and programs that have undergraduate majors relating to biotechnology are listed below. For more information, please contact the department or program, or phone the Iowa State Office of Admissions at 800 262-3810.

Agricultural and Biosystems Engineering

Department of Agricultural and Biosystems Engineering
102 Davidson Hall
Ames, IA 50011-3080
Phone: 515 294-1434
Fax: 515 294-6633
www.abe.iastate.edu

One of the options available to agricultural engineering majors is biosystems engineering. Students in biosystems engineering learn how to integrate the biological and physical sciences with engineering science and design. Graduates may work for companies involved with biotechnology, bioprocessing, bioenvironmental engineering, food engineering, and related areas.

Biotechnology developments have created opportunities for agricultural and biosystems engineers who design systems for biological and chemical processing and production of biomaterials. There are career opportunities in the areas of enzyme processing, bioreactor design, product separation, and bacterial treatment of agricultural and industrial products. Improving the quality of surface and groundwater by chemical and biological treatment has created new challenges. Agricultural engineers trained in biosystems are needed for biological product research and development, processing and production operations, plant management, and systems design. The expanding bioeconomy is creating opportunities for agricultural and biosystems engineers in biofuels and biorenewables.

Students who choose the biosystems option take courses in organic chemistry, biochemistry, and microbiology. They also are trained in engineering design and analysis focusing on living systems.

Agricultural Business and Economics

Department of Economics
Undergraduate Programs Office
174 Heady Hall
Ames, IA 50011-1070
Phone: 515 294-5436
Fax: 515 294-0221
E-mail: undergrad@econ.iastate.edu
www.econ.iastate.edu

Students who major in either agricultural business or economics learn how to evaluate the business and economic aspects of biotechnology alternatives and issues from the perspectives of consumers, business firms, and governmental agencies. Students also learn how to assess market impacts of biotechnology alternatives and related policies, including such things as prices, costs, and benefits. This knowledge is useful in developing business strategies and in formulating governmental policies involving biotechnology.

The Department of Economics offers a B.S. degree program in agricultural business through the College of Agriculture and a B.S. degree program in economics through the College of Liberal Arts and Sciences. The mission of the department is to provide high-quality research, educational, extension, and international programs in economics and agricultural economics. Graduates pursue a wide variety of careers in private industry, business, government, research organizations, or self-employment.

Agricultural Education and Studies

Department of Agricultural Education and Studies
201 Curtiss Hall
Ames, IA 50011-1050
Phone: 515 294-5872
Fax: 515 294-0530
www.ageds.iastate.edu

Technology, agriculture, and a desire to help others learn combine to make agricultural education a great career path.

Students in agricultural education learn how to teach and enhance learning about the latest technologies in agriculture, including biotechnology, bioethics, global positioning, environmental science, food technology, horticulture, and production agriculture. Graduates are prepared for a variety of careers in teaching, agribusiness, extension, and other government agencies.

The agricultural education profession rates Iowa State's agricultural education and studies department as one of the top departments of its kind in the nation. Usually, more than 90 percent of the department's students are employed by the time of graduation, and 98 percent are employed by six weeks after graduation.

Agronomy

Department of Agronomy
Student Services
1126 Agronomy Hall
Ames, IA 50011-1010
Phone: 515 294-3846
Fax: 515 294-8146
E-mail: agron@iastate.edu
www.agron.iastate.edu/academic/undergraduate

Agronomy is the synthesis of the plant, soil, and climate sciences in order to successfully grow economically and environmentally beneficial crops. Agronomists use biotechnology extensively in plant breeding, value-added crops, bioremediation, and phytoremediation.

Students in agronomy at Iowa State choose one of five options: plant breeding and biotechnology, agroecology, management and business, soil and environmental science, or research and development. Graduates in each option have opportunities for either graduate studies or immediate career placement. Students in plant breeding and biotechnology gain science-intensive state-of-the-art education in this dynamic discipline. Agroecologists study applied ecosystem science and are prepared for careers in sustainable agriculture. The management and business option prepares agronomic generalists who are ideally suited for careers in sales, technical services, seed production, and farming. The soil and environmental science option educates students for science careers pertaining to conservation and environmental quality. The research and development option is for students who want their B.S. to be a strong general plant science program.

Appendix 12.2

Animal Ecology

Department of Natural Resource Ecology and Management
339 Science II
Ames, IA 50011-3221
Phone: 515 294-6148
Fax: 515 294-7874
www.nrem.iastate.edu

Animal ecology is one of two curricula in the Department of Natural Resource Ecology and Management that offer unique career opportunities for students interested in biotechnology (also see forestry). Animal ecology focuses on the relationships of animals with their environment, both living and non-living components, in settings ranging from little human impact to human-dominated landscapes. Biotechnology plays a central role in many aspects of animal ecology, such as fish/wildlife forensics at the domestic and international level, identifying and controlling emergent diseases in fish and wildlife, managing for genetic diversity in species of conservation concern, and determining taxonomic status as a basis for conservation policy.

Animal ecology provides options for students to specialize in wildlife, fisheries and aquatic science, or preveterinary and wildlife care studies. Graduates from these programs develop careers in management of fish or wildlife, law enforcement, veterinary medicine, and conservation biology, among others. Developing both the knowledge base in animal ecology and the biotechnology skills used to solve some important problems facing wild species today is an attractive combination to potential employers. Qualified students are encouraged to participate in the Honors Program, which provides one of the best ways to individualize their program of course work to achieve the particular emphasis on biotechnology aspects of animal ecology that they desire.

Animal Science

Department of Animal Science
119 Kildee Hall
Ames, IA 50011-3150
Phone: 515 294-3161
Fax: 515 294-0018
E-mail: answeb@iastate.edu
www.ans.iastate.edu

Animal scientists provide services related to animal production and animal products. Students in the animal science department learn how to provide services that are economical and consistent with consumer needs, animal well-being, resource conservation, and environmental protection. A degree in animal science or dairy science also can prepare students for admission to professional schools, such as veterinary medicine.

For the animal science major interested in biotechnology, faculty members in animal breeding and genetics, physiology of reproduction, muscle biology, nutritional physiology, meat science, and animal nutrition have laboratory-based programs that offer undergraduates biotechnology research experience. Specific areas of research include, but are not limited to, the molecular analysis of genes and gene products of biological and economic importance in livestock, such as gene expression, gene function, gene mapping, protein expression and function; the development of biological and physiological methods to analyze muscle; the study of nutritional modification to improve nutrient utilization; and the development and use of gene transfer methods to improve livestock characteristics.

Biochemistry, Biophysics and Molecular Biology

Department of Biochemistry, Biophysics, and Molecular Biology
1210 Molecular Biology Building
Ames, IA 50011-3260
Phone: 515 294-6116
Fax: 515 294-0453
E-mail: biochem@iastate.edu
www.bb.iastate.edu

The Department of Biochemistry, Biophysics and Molecular Biology offers B.S. majors in biochemistry, agricultural biochemistry, and biophysics, all of which are appropriate to careers in biotechnological sciences. The three programs focus on the explanations of life processes in terms of fundamental chemical and physical principles. The curricula include in-depth quantitative study in mathematics, chemistry, and physics, in addition to biological sciences with special emphasis on the molecular level. Advanced, state-of-the-art laboratory training in biochemistry and molecular biology is a featured aspect of the majors, including opportunities for individual undergraduate research projects integrated into the professional research programs of our faculty members. Training in these majors provides fundamental knowledge and experience that allow our graduates to function as scientific staff in the biotechnology industry and to advance to graduate-level training leading to research director positions in biotechnology. Some of the relevant biotechnology areas are pharmaceuticals, plant genetic engineering, animal health, and human medical research.

Biology

Biology Program
103 Bessey Hall
Ames, IA 50011-1020
Phone: 515 294-1064
Fax: 515 294-0803
E-mail: biology@iastate.edu
www.biology.iastate.edu

Biology is the study of all aspects of life on this planet. Biologists will learn about plants and animals, ecology and molecular biology, genetics and physiology, and biotechnology and evolution.

The biology program at Iowa State University provides a broad education in all aspects of modern biology. It also can serve as a basis for students interested in more specific areas like animal ecology, biochemistry, botany, entomology, genetics, microbiology, or zoology.

Undergraduate biology majors are encouraged to work in some of the more than 200 biological sciences laboratories on campus, to study at a marine research station, to take courses at the Iowa Lakeside Laboratory, or to study the ecology of a foreign land. Biology majors are ideally suited for further graduate and professional training; employment in health, agricultural, biotechnology, or environmental professions; and work in education.

Appendix 12.2

Biomedical Sciences

Department of Biomedical Sciences
2008 Veterinary Medicine
Ames, IA 50011-1250
Phone: 515 294-2440
Fax: 515 294-2315
E-mail: biomedsci@iastate.edu
www.vetmed.iastate.edu/departments/bms

The Department of Biomedical Sciences at Iowa State University studies anatomy, histology, molecular biology, cell biology, physiology, and pharmacology. It is a foundation subject that includes the study of normal functions of mammalian animals. The department teaches undergraduate students who use the subject for furthering preprofessional and paraprofessional studies. The department also teaches doctor of veterinary medicine (DVM) students in the first three years of their program. The graduate students study biomedical sciences with option of focus on four specialties. These specialties are cell biology, physiology, physiology and pharmacology, and anatomy. DVM and graduate students conduct research in the areas of faculty specialties that include neuroscience, neurotoxicology, parasite biology, and pharmacology. Graduate students of the DVM program go into a wide range of careers, including veterinary practice. Graduate students frequently enter careers in research and teaching at other universities.

Chemical and Biological Engineering

Department of Chemical and Biological Engineering
2114 Sweeney Hall
Ames, IA 50011-2230
Phone: 515 294-7643
Fax: 515 294-2689
E-mail: cheme-advising@iastate.edu
www.cbe.iastate.edu

Chemical engineering is the study of the use of chemical methods to make new materials, including bulk chemicals and fuels, pharmaceuticals, construction materials, foodstuffs, synthetic textiles, plastics, and advanced materials. Chemical engineers are skilled in chemistry, mathematics, and physics, as well as in engineering subjects such as fluid mechanics, heat and mass transfer, separations of chemical components, thermodynamics, reactor engineering, process control, and plant design.

Because chemical engineers have a thorough knowledge of chemistry, it is common for them to move into biotechnology. Chemical engineering students often take courses in biochemistry, microbiology, genetics, and food science, and nearly half ultimately work in the biotechnology industry. Many graduate students and undergraduates also conduct research within the department on biological topics such as plant metabolic engineering, protein separations, secondary metabolite production, enzyme mutagenesis, modeling of enzyme structure and function, biorenewables, phytoremediation, drug delivery, and biocompatible polymers.

Chemistry

Department of Chemistry
1608 Gilman Hall
Ames, IA 50011-3111
Phone: 515 294-6352
Fax: 515 294-0105
E-mail: isuchemistry@iastate.edu
www.chem.iastate.edu

Chemistry is the study of the composition, structure, properties, and interactions of chemicals. Because chemicals are the basis of life, chemists study a wide range of topics. Some are intrigued by environmental problems such as global warming, ozone depletion, or acid rain. Some chemists work with other researchers to seek cures for diseases. Other chemists enjoy synthesizing new materials. Emerging areas include nanotechnology and microanalytical instrumentation.

A chemistry degree from Iowa State can qualify you for a career as an environmental chemist, pharmaceutical chemist, forensic scientist, science writer, technical salesperson, product development chemist, or research worker. Many Iowa State chemistry graduates are professors at noted universities and colleges, researchers in well-known industrial laboratories, or leaders in world business and commerce. Undergraduate chemistry majors may continue in graduate school or professional studies related to biotechnology.

Civil, Construction, and Environmental Engineering

Department of Civil, Construction, and Environmental Engineering
394 Town Engineering Building
Ames, IA 50011-3232
Phone: 515 294-3532
Fax: 515 294-8216
www.ccee.iastate.edu

One of the options available to civil engineering majors is environmental engineering. In the field of environmental engineering, students can be involved in environmental biotechnology, which is the multidisciplinary integration of sciences and engineering in utilizing the biochemical potential of microorganisms, plants, and parts thereof for the restoration and preservation of the environment and for the sustainable use of resources. Graduates of environmental engineering find work in state and federal government, such as the Environmental Protection Agency, consulting companies, and national laboratories. Some of the work in which students are involved includes studying the fate and transport of pollutants, bioremediation, and the use of molecular tools to probe and understand the behavior of microorganisms in utilizing and biodegrading pollutants in the environment.

Computer Science

Department of Computer Science
226 Atanasoff Hall
Ames, IA 50011-1041
Phone: 515 294-4377
Fax: 515 294-0258
E-mail: csdept@cs.iastate.edu
www.cs.iastate.edu

Computer scientists engage in fundamental and applied research; design, analysis, and development of algorithms; software; databases; and information systems and their applications across virtually every area of human endeavor.

The Department of Computer Science actively participates in biotechnology education and research at Iowa State in a variety of ways. Several computer science faculty members conduct research in bioinformatics and computational biology, a discipline that is critical to the advances in animal and plant agriculture, drugs, biomaterials, and foods. Computer science faculty work on the development of information systems and data mining software that can aid in the discovery of predictive models and relationships from complex data sets, for example, in the discovery of macromolecular sequence-structure-function relationships, in discovery of quantitative structure-activity relationships (QSAR) for rational drug design, and in precision farming. Several computer science faculty members have expertise in computational modeling of complex systems.

Undergraduate students interested in biotechnology can take courses in programming, data bases, information systems, machine learning (data mining), bioinformatics, and related areas as part of an undergraduate minor in computer science. Research projects led by computer science faculty, often in collaboration with colleagues with expertise in biological, biomedical, and agricultural sciences, offer a broad range of research and research-based advanced training opportunities to qualified undergraduate students.

Appendix 12.2

Electrical and Computer Engineering

Department of Electrical and Computer Engineering
2215 Coover Hall
Ames, IA 50011-3060
Phone: 515 294-2664
Fax: 515 294-3637
E-mail: ecpe@iastate.edu
www.ece.iastate.edu

Electrical and computer engineering plays a central role in the design and development of electrical devices and in applying computers to a variety of problems. Electrical engineering students apply the theories and technologies in system modeling and control, signal analysis and filtering, and electrical device design toward modeling and sensing biological systems. Computer engineers apply their background in algorithm development, network analysis, and software engineering to improving biomedical software and sensor networks.

The Department of Electrical and Computer Engineering supports biotechnology development in a variety of ways, such as designing biomedical instrumentation, biomedical image processing, and bioinformatics. Department faculty are active in the Plant Sciences Institute and the bioinformatics and computational biology interdisciplinary program. Many graduate and undergraduate students work with faculty performing research in areas such as algorithm design for more efficient assembly of large genomes, systems biology modeling of complex biological systems, surgical simulation using biomedical images in virtual reality, and instrumentation related to medical and biological applications.

Entomology

Department of Entomology
110 Insectary Building
Ames, IA 50011-3140
Phone: 515 294-7400
Fax: 515 294-7406
E-mail: entomology@iastate.edu
www.ent.iastate.edu

Entomology is the scientific study of insects. Entomology students are trained in the evolutionary and ecological relationships of insects with other life forms; the principles of insect structure and function; the impact of insects relative to human and animal health; and the relationships between insects and humanity's food, fiber, structural and aesthetic needs and expectations. Graduates understand the principles and methods available to manage beneficial and pest insect populations. The Department of Entomology offers research opportunities for undergraduates interested in biotechnology, which has revolutionized strategies used for management of insect pests and insect vectored diseases of humans, plants, and animals. Entomology majors are prepared for further graduate and professional training or for a wide range of positions within industry, business, government, education, and public health.

Food Science and Human Nutrition

Department of Food Science and Human Nutrition
2312 Food Sciences Building
Ames, IA 50011-1061
Phone: 515 294-3011
Fax: 515 294-8181
E-mail: fshnweb@iastate.edu
www.fshn.hs.iastate.edu

Students who select the food science major in the Department of Food Science and Human Nutrition apply the basic principles of biology, chemistry, and physics in studying the quality, preservation, preparation, and safety of foods. Students who choose the nutritional science major investigate the interactions and effects of food components, for good or ill, in the human body.

Students can work with faculty studying the molecular mechanisms of carcinogenesis, developing means to recover cloned proteins from plants, improving microorganisms to carry out valuable fermentation processes, or investigating the cellular reactions in lipid metabolism. A course in food biotechnology follows the production of food enzymes from gene cloning through fermentation and protein recovery.

Forestry

Department of Natural Resource Ecology and Management
339 Science II
Ames, IA 50011-3221
Phone: 515 294-6148
Fax: 515 294-7874
www.nrem.iastate.edu

Forestry is one of two curricula in the Department of Natural Resource Ecology and Management that offer unique career opportunities for students interested in biotechnology (also see animal ecology). Forestry focuses on conservation, renewal, and utilization of trees and their associated plant and animal communities across the spectrum from wilderness areas to urban tree populations and industrial plantations. Because trees and forests develop over longer time spans than most organisms, biotechnology is playing a particularly important role in understanding how genetics and environment interact to determine the health and utilization qualities of trees, the level of population diversity in natural stands, and the impacts of management on diversity. Many biotechnology approaches will be developed in the future to optimize the production of consumer goods from wood, one of earth's most abundant and renewable resources.

The forestry curriculum provides options for students to specialize in forest ecosystem management, conservation and restoration, or materials science and technology. Graduates from these programs pursue rewarding careers with a variety of government agencies, forest industries, and public conservation organizations. Qualified students are encouraged to participate in the Honors Program, which provides one of the best ways to individualize their program of course work to achieve the particular emphasis on biotechnology aspects of forestry that they desire.

Genetics

Undergraduate Genetics Major
103 Bessey Hall
Ames, IA 50011-1020
Phone: 515 294-1606
Fax: 515 294-0803
E-mail: ug-genet@iastate.edu
www.public.iastate.edu/~ugradgen

Genetics is the study of how characteristics of living organisms are passed from generation to generation. Students with the B.S. degree may find employment in the biotechnology, health, or food industries. Recent graduates have developed careers in conservation biology, technical writing, science journalism, technical sales, biological illustration, and genetic counseling. Many students are finding that the genetics major is very good preparation for professional studies in human or animal medicine.

Genetics students pursue a rigorous program of chemistry, physics, math, biology, and genetics that prepares them for graduate programs in any area of genetics or other biological sciences. With more than 60 faculty campuswide conducting research in genetics, exceptional opportunities exist for genetics majors to do undergraduate internships.

continued on back

Majors/continued

Health and Human Performance

Department of Health and Human Performance
Head of Undergraduate Advising
Ames, IA 50011-1160
Phone: 515 294-8009
Fax: 515 294-8740
E-mail: hhp@iastate.edu
www.hhp.hs.iastate.edu

Health and human performance involves the study of physical activity and its influence on health and well-being. One of the options in the B.S. in health and human performance is exercise science. Exercise science allows students to develop a program of study around the biotechnological aspects of human performance. In particular, our students acquire knowledge and skills involving the interaction of biological, mechanical, and control aspects of human movement and physical activity. For example, students may participate in faculty laboratories on human performance research, particularly involving the molecular, biochemical, biomechanical, and neurological aspects. Course work in the exercise science option may be tailored to a student's individual interest and focus, particularly a student seeking further professional education in health-related fields such as medicine, physical therapy, occupational therapy, or graduate study in physical activity and health.

Horticulture

Department of Horticulture
106 Horticulture Hall
Ames, IA 50011-1100
Phone: 515 294-3718
Fax: 515 294-0730
www.hort.iastate.edu

Horticulture promotes the creative utilization of plants to improve society. Biotechnology is an important tool used to study and improve horticultural crops.

The Department of Horticulture offers numerous research opportunities for undergraduates through honors programs, independent study, and the science option within the horticulture major. Students may choose to work with faculty and experienced graduate students on a broad array of research projects, including molecular biology of fruit ripening and development, physiology of disease resistance, molecular controls of vegetative growth, transgenic plant production and analysis, micropropagation of ornamental plants, and woody plant physiology. Several undergraduate courses offer some training in the principles and techniques of biotechnology.

Graduates of the horticulture program become fruit and vegetable producers, turfgrass managers at golf courses and sports fields, lawn care professionals, nursery crop producers and garden center managers, landscape design and installation professionals, public garden and arboreta horticulturists and educators, plant biologists, garden writers and communication specialists, and greenhouse managers.

Mathematics

Department of Mathematics
396 Carver Hall
Ames, IA 50011-2064
Phone: 515 294-1752
Fax: 515 294-5454
E-mail: mathematics@iastate.edu
www.math.iastate.edu

With increased availability of DNA and other data, quantitative methods have become central to many fields in biotechnology. Diverse fields of mathematics are now used, for example, to uncover phylogenetic relationships among species using DNA, to model population growth and epidemics, to predict the shapes of proteins, and to model the growth of cancers. All these topics require advanced mathematics.

Mathematics majors normally spend the first two years obtaining a grounding in calculus and differential equations. At the junior and senior levels, the department offers undergraduate courses relevant to different topics in biotechnology. Mathematics provides tools for deeper analysis of many subjects taught in other departments.

Microbiology

Undergraduate Interdepartmental Microbiology Program
207 Science I
Ames, IA 50011-3211
Phone: 515 294-6831
Fax: 515 294-6019
E-mail: microundergrad@iastate.edu
www.micro.iastate.edu

Microbiology is the study of living organisms that generally are seen only with a microscope. Some microbes are devastating pathogens of humans, animals, or plants or cause serious problems in food production systems. Microbiologists study the interaction of microbes with other organisms or with the environment in order to solve problems caused by microbes or to use microbes for their advantageous properties. For example, microbiologists study how microbes cause diseases, or they study and devise ways to manipulate microorganisms to produce products of interest, such as antibiotics, insulin, or vaccines. Industrial microbiologists are responsible for generating and maintaining the bacterial cultures that produce compounds needed in human and animal medicine each day.

A microbiology major will study genetics, chemistry, biochemistry, physics, and cell biology, in addition to medical microbiology and microbial physiology and genetics. Microbiology majors often participate in the microbiology club, first- and second-year learning communities, and research internships in on-campus or local company laboratories. Microbiology students interested in biotechnology often take advanced course work in immunology, virology, cell biology, and plant pathology. In the past, students graduating with a B.S. in microbiology from Iowa State University quickly have found jobs working in genetics-based biotechnology companies, in pharmaceutical companies developing new drugs and vaccines, and in state or federal research laboratories like the United States Department of Agriculture's animal research laboratories in Ames. Microbiology graduates also are well prepared to enter graduate and professional programs or clinical laboratory scientist programs designed to train personnel to work in hospitals. In short, a degree in microbiology prepares students for careers in food, industrial or environmental microbiology, or animal health and plant pathology, or it provides the preparation needed to succeed in graduate school or professional programs, such as veterinary or medical school.

Appendix 12.2

Philosophy and Religious Studies

Department of Philosophy and Religious Studies
402 Carrie Chapman Catt Hall
Ames, IA 50011-1306
Phone: 515 294-7276
Fax: 515 294-0780
www.iastate.edu/~ethics

Philosophy studies the most general features of our world, the fundamental principles of value, and the nature and methods of knowledge. The Department of Philosophy and Religious Studies at Iowa State offers undergraduate majors that can prepare students for graduate work in philosophy or in religious studies, or for further study in law, history, political science, or literature.

Offerings in philosophy include theoretical and applied ethics, the philosophy of biotechnology, environmental ethics, general philosophy of science, and the philosophy of biology. Through studying social and political philosophy and the philosophy of technology, students can learn about the political ideas that may affect the adoption or regulation of biotechnology discoveries.

Offerings in religious studies enable students to examine the practices and ideas of the world's religions and their effects on ways of living. Students can explore religious ethical beliefs that have important consequences for the adoption of particular biotechnologies.

Physics and Astronomy

Department of Physics and Astronomy
12B Physics Hall
Ames, IA 50011-3160
Phone: 515 294-5440
Fax: 515 294-6027
E-mail: phys_astro@iastate.edu
www.physics.iastate.edu

Physics and astronomy are basic natural sciences that attempt to describe and provide an understanding of our world. They serve as the underpinning of many different disciplines, including the other natural sciences and technological areas. Students may choose physics for their major subject as preparation for diverse areas, such as engineering, medicine, law, or business administration, or simply as a challenging approach to personal development with an emphasis on rigorous scientific thinking. Other students choose physics as preparation toward a career as a professional physicist or a science educator.

The physics of biological systems program in the Department of Physics and Astronomy is a highly interdisciplinary research program that involves the development and application of experimental and theoretical methods to understand biology from a physical perspective. This program is designed to provide the quantitative skills and the biological background for students who would like to pursue careers in fundamental research in biophysics, quantitative biology, and biotechnology. Current research areas include macromolecular structural determination, structure and function of biological membranes, bioinformatics, and computational biology.

Political Science

Department of Political Science
509 Ross Hall
Ames, IA 50011-1204
Phone: 515 294-8682
Fax: 515 294-1003
E-mail: polsci@iastate.edu
www.pols.iastate.edu

The Department of Political Science prepares students for careers in law and public service. Students interested in public policy, public administration, American politics, comparative politics, international relations, or political theory will find issues related to biotechnology to be an important part of their studies in a wide array of departmental courses. Legislatures, executives, courts, political parties, and interest groups in the United States and many other countries deal with the economic, environmental, and political consequences of biotechnology. These political participants and issues are often an important component of our curricular offerings.

In particular, the Department of Political Science addresses aspects of biotechnology in its courses on environmental politics, constitutional law, ethics and political theory, and international political economy. The department also offers courses on public administration and administrative laws that assess the political and legal requirements for the implementation of laws related to biotechnology issues.

Statistics

Department of Statistics
325 Snedecor Hall
Ames, IA 50011-1210
Phone: 515 294-3440
Fax: 515 294-4040
E-mail: statistics@iastate.edu
www.stat.iastate.edu

Statistics is the science of collection, organization, analysis, and interpretation of data. The principles of statistics apply to a wide variety of professional and scientific fields.

There are many opportunities for students to apply methodology learned in statistics courses to biotechnology research. In courses about design of experiments and survey sampling, students learn how to efficiently collect data. Courses in applied probability modeling include applications in bioinformatics and genomics. Courses in time series analysis and spatial data analysis examine patterns in data related to time and space. Students may wish to combine a major in a biotechnology field with a second major, or minor, in statistics.

Biotechnology

Become YOUR BEST

Preparing to do your best while you're in high school

To prepare for a career in biotechnology at Iowa State University, you should focus on science, mathematics, and English while you are in high school. Taking three years of one foreign language in high school, earning advanced placement credits, or taking community college classes can give you a head start on your university studies. Entrance requirements are not the same for all academic departments at Iowa State, so contact the department of your choice for specifics. Try to follow these general recommendations for courses you should take in high school:

Sciences
biology, chemistry, physics

Mathematics
algebra, calculus, geometry, trigonometry

Language arts
English grammar and writing courses, foreign language

Getting to know biotechnology at Iowa State

Iowa State University is a public land-grant institution that has earned a world-class reputation for leadership in the life sciences. Biotechnology has added to that reputation.

Since our biotechnology program was established in 1984, Iowa has invested millions of dollars to keep Iowa State among the leaders in biotechnology education, research, and outreach. That investment is paying off in many research firsts and unique programs. If you want to be among the best in 21st century biotechnology, Iowa State is the place to be. You can read about all of the biotechnology opportunities offered by Iowa State University at www.biotech.iastate.edu.

Broaden your horizons

Honors
The Honors Program provides opportunities for high-achieving students to do their best early in their years at Iowa State. An individualized academic program, priority scheduling for courses, smaller class sizes, independent research projects, and a mentoring relationship with renowned faculty members are benefits for students who qualify.

Internships
Internships and other cooperative education experiences are available to students in many academic departments. In addition to giving you a head start in building on-the-job experience for your future career, these paid positions can help you finance your education.

Learning Communities
A course-based learning community is a small group of students with similar academic goals who work and learn together in study groups. Students may take their courses together and have a ready-made set of potential friends. Many undergraduate departments at Iowa State offer students the opportunity to be part of a learning community family.

Study Abroad
Students who want to study life sciences in the international arena can choose their special spot in the world. Earn academic credits while you study in Mexico, the Philippines, China, the Ukraine, Australia, Spain, France, Greece, or many other countries. You'll find many exciting options for both the academic semesters and the summer.

Student Organizations
Iowa State has a wide variety of clubs and special interest groups for students. The following activities may be of interest to students in the life sciences:

Agronomy Club
American Institute of Chemical Engineers
Biochemistry, Biophysics, and Molecular Biology Club
Biological Sciences Club
Family and Consumer Sciences Education and Studies Club
Fisheries and Wildlife Biology Club
Food Science Club
Forestry Club
Mathematics Club
Pre-Medical Club
Student Chapter of the American Veterinary Medical Association
Undergraduate Microbiology Club

Honor societies include:
Alpha Kappa Delta – Sociology
Alpha Zeta – Agriculture
Beta Beta Beta – Biological Sciences
Omega Chi Epsilon – Chemical Engineering
Phi Beta Kappa – Liberal Arts and Sciences
Phi Upsilon Omicron – Family and Consumer Sciences
Pi Mu Epsilon – Mathematics
Upsilon Pi Epsilon – Computer Science
Xi Sigma Pi – Forestry

For more information

If you have questions or want more detailed information about Iowa State's Biotechnology Program, please contact:

Iowa State University
Office of Biotechnology
1210 Molecular Biology Building
Ames, Iowa 50011-3260
Phone: 515 294-9818
E-mail: biotech@iastate.edu
www.biotech.iastate.edu

Preparing to study at Iowa State University

The best preparation continues to be a strong college preparatory program of study, which includes courses in English, mathematics, laboratory science, social studies, and foreign languages. If you intend to transfer credits from another institution, you may contact our Office of Admissions for assistance in selecting the best courses for your program of study.

Questions about admission

In addition to writing us at the address below, we encourage you to visit our Web site, which features a course catalog, online application, and campus information.

Iowa State University
Office of Admissions
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04/06

Appendix 12.3

Office of Biotechnology Fellowship Awards

1987-2009

Department or program abbreviations:

BBMB Biochemistry, Biophysics and Molecular Biology
MCDB Molecular, Cellular and Developmental Biology
VMPM Veterinary Microbiology and Preventive Medicine
VMRI Veterinary Medicine Research Institute

Name	Department or Program	Fiscal Year
Beavais, Sheryl	Toxicology	Before 1993
Blonigen, Scott	Chemical Engineering	Before 1993
Boettcher, Paul	Animal Science	Before 1993
Brault, Veronique	Plant Pathology	Before 1993
Brown, Dan	Animal Science and Zoology	Before 1993
Byrne, Dennis	Botany	Before 1993
Caffrey, James	MCDB	Before 1993
Chen, Yunfei	Immunobiology	Before 1993
Chuang, Tsung-Hsien	MCDB	Before 1993
Crawford, Maria	Biochemistry	Before 1993
Delgado, Michael	Biochemistry/Biophysics and Zoology	Before 1993
Diers, Brian	Agronomy	Before 1993
Flaming, Kevan	Immunobiology	Before 1993
Fox, Charles	MCDB	Before 1993
Geraghty, Anne	Botany	Before 1993
Girton, Lois	Genetics	Before 1993
Held, Bruce	Plant Physiology	Before 1993
Hellwig, Dianne	Veterinary Pathology/VMRI	Before 1993
Heng, Meng	Chemical Engineering	Before 1993
Hou, Zhen	MCDB	Before 1993
Jarvill-Taylor, Karalee	MCDB	Before 1993
Johnson, Mike	VMRI/VMPM	Before 1993
Kaiserman, Howard	Zoology	Before 1993
Keim, Paul	Agronomy	Before 1993
Kudej, Raymond	Biomedical Engineering	Before 1993
Link, Greg	Animal Science	Before 1993
Marini, Nicholas	MCDB	Before 1993
Mohideen, Manzoor	MCDB	Before 1993
Munns, Paula	Immunobiology	Before 1993
Pearson, Paul	MCDB	Before 1993
Prasad, T.K.	Zoology	Before 1993
Proescholdt, Terry	Immunobiology	Before 1993
Pusateri, Anthony	Biochemistry/Biophysics	Before 1993
Raggon, Jeffrey	Chemistry	Before 1993
Rakow, Terese	MCDB	Before 1993
Schmidt, Michelle	Toxicology	Before 1993
Smiley, Brenda	MCDB	Before 1993
Stabel, Tom	VMRI, VMPM, and Zoology	Before 1993
Suominen, Ilari	Chemical Engineering	Before 1993
Thomas, P.J.	Chemistry	Before 1993
Tian, Jin	Plant Physiology	Before 1993
Vahle, John	Veterinary Pathology	Before 1993
Veldboom, Lance	Agronomy	Before 1993
Winder, Thomas	Botany	Before 1993

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Name	Department or Program	Fiscal Year
Woskow, Steven	Chemical Engineering	Before 1993
Kuehl-Kovarik, Cathleen	Veterinary Anatomy	1993
Vahle, John	Veterinary Anatomy	1993
Austin, David	Agronomy	1994
Krieger, Karen	Interdepartmental Genetics	1994
Krulic, Jennifer	Interdepartmental Genetics	1994
Luning, Niu	MCDB	1994
Ross, Tamara	Zoology/Genetics	1994
Cheancy, James	Interdepartmental Genetics	1995
Klonglan, Suzanne	MCDB	1995
Miller, Adam	Interdepartmental Plant Physiology	1995
Schuchaskie, Susan	MCDB	1995
Small, Randall	Interdepartmental Genetics	1995
Sun, Jingdang	Interdepartmental Plant Physiology	1995
Cook, Kevin	Agronomy	1996
Rozema, Brad	Interdepartmental Plant Physiology	1996
Smith, Heather	Interdepartmental Genetics	1996
Stickney, John	Biochemistry/Biophysics	1996
Visser, Joel	Interdepartmental Genetics	1996
Benson, Tammy	Interdepartmental Genetics	1997
Isler, Bradley	MCDB	1997
Jiang, Yun	Chemistry	1997
Milne, Carrie	Interdepartmental Genetics	1997
Nielsen, Corinne	Interdepartmental Genetics	1997
Tong, Wenfer	Biochemistry/Biophysics	1997
Wu, Wei	Interdepartmental Genetics	1997
Hu, Yanhui	Chemical Engineering	1998
Huang, Yeng	MCDB	1998
Irwin, Phillip	Food Science Human Nutrition	1998
Liu, Fang	Interdepartmental Genetics	1998
Stoltzfus, David	Agronomy	1998
Tang, Wei	MCDB	1998
Wang, Dong	Interdepartmental Genetics	1998
Wang, Yanqin	Interpartmental Plant Physiology	1998
Xie, Mei-Min	MCDB	1998
Yunker, Stephanie	Interdepartmental Genetics	1998
Chen, She	MCDB	1999
Gu, Jianying	Interdepartmental Genetics	1999
Jiang, Cizhong	Interdepartmental Genetics	1999
Leahy, Nicole	Interdepartmental Genetics	1999
Peng, Shenquan	Toxicology	1999
Shen, Ruizhong	Interdepartmental Genetics	1999
Yun, Ji	Neuroscience	1999
Zhang, Yuan	MCDB	1999
Belden, Jason	Toxicology	2000
Chin, Yvette	Interdepartmental Genetics	2000
Liu, Gumei	Neuroscience	2000
Wang, Bing-Bing	Interdepartmental Genetics	2000
Wills, Nick	Immunology	2000
Zhang, Feng	Interdepartmental Genetics	2000
Chuan, Shen	Toxicology	2001
Cong, Xiangyu	BBMB	2001
Cui, Feng	Bioinformatics and Computational Biology	2001
Kipper, Matthew	Chemical Engineering	2001
Lakshiminarasimhan, Krishnaswamy	Plant Physiology	2001

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Name	Department or Program	Fiscal Year
Liu, Juan	MCDB	2001
Maki, Jennifer	Biochemistry/Biophysics	2001
Pieris, Shayani	Plant Physiology	2001
Powers, Bradley	Bioinformatics and Computational Biology	2001
Shukla, Sachet	Bioinformatics and Computational Biology	2001
Vigdal, Thomas	Bioinformatics and Computational Biology	2001
Wang, Xiangyun	Bioinformatics and Computational Biology	2001
Ye, Liang	Interdepartmental Genetics	2001
Zhang, Fan	BBMB	2001
Zhao, Honghua	Interdepartmental Genetics	2001
Bootsma, Jason	Chemical Engineering	2002
Clark, Bryan	Toxicology	2002
Cummings, Matthew	Entomology	2002
Determan, Matthew	Chemical Engineering	2002
Huang, Zhonglian	Interdepartmental Genetics	2002
Kipper, Matthew	Chemical Engineering	2002
Lerach, Stephanie	Interdepartmental Genetics	2002
Wang, Jizhen	Interdepartmental Genetics	2002
Wang, Tianjiao	MCDB	2002
Wu, Feihong	Bioinformatics and Computational Biology	2002
Zhang, Mingxu	Neuroscience	2002
Zhang, Xiaoli	MCDB	2002
Zhao, Hua	Bioinformatics and Computational Biology	2002
Zhao, Wei	MCDB	2002
Cai, Huaya	Interdepartmental Plant Physiology	2003
Dahlstrom, Michael	Biochemistry/Biophysics	2003
Duanmu, Dequiang	MCDB	2003
Hopper, Brian	Toxicology	2003
Koukuntla, Ramesh	Interdepartmental Genetics	2003
Lee, Jae-Hyung	Bioinformatics and Computational Biology	2003
Lei, Liying	Immunobiology	2003
Liu, Zhiping	Immunobiology	2003
Min, Lie	BBMB	2003
Morrone, Dana	BBMB	2003
Ru, Yuanbin	Interdepartmental Genetics	2003
Steelman, Carissa	Interdepartmental Genetics	2003
Sun, Faneng	Neuroscience	2003
Yang, ChunYing	Interdepartmental Genetics	2003
Yi, Hou	MCDB	2003
Zhang, Danhui	Neuroscience	2003
Zheng, Ying	Bioinformatics and Computational Biology	2003
Zhu, Haiyan	MCDB	2003
Couture, Oliver	Interdepartmental Genetics	2004
Dancik, Garrett	Bioinformatics and Computational Biology	2004
Fang, Xiaowen	Chemistry	2004
Hillwig, Matthew	MCDB	2004
Janku, Eric	Bioinformatics and Computational Biology	2004
Jin, Huajun	MCDB	2004
Jin, Huanan	Plant Physiology	2004
Liu, Yinghua	MCDB	2004
Lu, Shen	BBMB	2004
Severin, Andrew	BBMB	2004
Todd, Michael	Neuroscience	2004
Xiao, Xiangjun	MCDB	2004
Yang, Xu	Plant Physiology	2004

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Name	Department or Program	Fiscal Year
Ziegler, Martha	MCDB	2004
Aspelund, Matthew	Chemical Engineering	2005
Chandler, Christopher	Ecology	2005
Chaudhuri, Biswajoy	BBMB	2005
Cheng, Shouqiang	BBMB	2005
Chung, Choongseo	Bioinformatics and Computational Biology	2005
Derscheid, Rachel	Veterinary Pathology	2005
Fan, Chenguang	BBMB	2005
Huang, Yong	Bioinformatics and Computational Biology	2005
Jin, Jing	MCDB	2005
Liu, Yu	Immunobiology	2005
Nielsen, Lindsay	Microbiology	2005
Rohlik, April	Microbiology	2005
Song, Xiaoling	Interdepartmental Genetics	2005
Sparkman, Amanda	Ecology and Evolutionary Biology	2005
Studham, Matthew	Bioinformatics and Computational Biology	2005
Tang, Hailin	Toxicology	2005
Tanghe, Kelly	Food Science Human Nutrition	2005
Tong, Jiansong	BBMB	2005
Xi, Chen	Plant Physiology	2005
Yu, Chuanhe	Horticulture	2005
Zabeck, Peter	Bioinformatics and Computational Biology	2005
Zhai, Lijie	Immunobiology	2005
Zhang, Chengliang	Interdepartmental Genetics	2005
Zhiyong, Shao	Interdepartmental Genetics	2005
Fang, Xiaowen	Chemistry	2006
Harvey, Megan	Genetics	2006
Straker, Michaela	Toxicology	2006
Tong, Fan	Toxicology	2006
Xia, Tian	Bioinformatics and Computational Biology	2006
Yang, Xiao	Bioinformatics and Computational Biology	2006
Baskett, James	Genetics	2007
Fenner, Carrie	Microbiology	2007
Flaugh, Shannon	Ecology and Evolutionary Biology	2007
Grantham, Lisa	MCDB	2007
Huang, Min	Plant Physiology	2007
Reding, Dawn	Ecology and Evolutionary Biology	2007
Sinha, Divya	MCDB	2007
Ulrey, Bret	Chemical and Biological Engineering	2007
Zhao, Yingsheng	Genetics	2007
Anderson, Rachel	Interdepartmental Genetics–Nutritional Sciences	2008
Dust, Drew	MCDB	2008
Duthie, Brad	Ecology and Evolutionary Biology	2008
Lang, Krista Euken	Natural Resource Ecology and Management	2008
Mukerjee, Shreyartha	Bioinformatics and Computational Biology	2008
Snell, Ryan	Chemical and Biological Engineering	2008
Zimmerman, Michael	Bioinformatics and Computational Biology	2008
Chou, Hsien-chao	Bioinformatics and Computational Biology	2009
Jeffrey, Brandon	Interdepartmental Genetics–Genetics	2009
Mitchell, Timothy	Ecology and Evolutionary Biology	2009
Muppirala , Usha	Bioinformatics and Computational Biology	2009
Saldanha, Jenifer	MCDB	2009
Sethuraman, Arun	Bioinformatics and Computational Biology	2009
Bigus, Sarah	Interdepartmental Genetics–Genetics	2010
Koons, Susan	Bioinformatics and Computational Biology	2010

Appendix 12.4

FACULTY DEVELOPMENT
FY92-2009

1) *TGF-beta and related proteins symposium* – Marit Nilsen-Hamilton/Richard Hamilton (September 1991)

2) West Central States Biochemistry Conference – James Thomas (Fall 1991)

3) Animal Science 451X – Donald Beitz (January 1992)

4) Life Sciences Symposium – Marit Nilsen-Hamilton (March 1992)

5) Electron Microscopy Symposium – Warren Straszheim (May 1992)

6) *Characterization and Quantitation of Immunogens in Veterinary Biologics* – James Roth (May 1992)

7) 9th International Congress of the International Organization for Microplasmology – Richard Ross and Chris Minion – August 1992.

8) *The role of insulin-like growth factors and their receptors in development* – Marit Nilsen-Hamilton (September 1992)

9) Introduction to Instrumentation Facilities – Carol Jacobson (Summer 1993)

10) Life Sciences Symposium – Bernard White (March 1993)

11) 30th Electron Microscopy Colloquium – Bruce Wagner (April 1993)

12) Introduction to the Instrumentation Facilities for Biotechnology Research – Kristi Harkins (Spring 1993)

13) *Symposium on fibroblast growth factors in development and disease* – Marit Nilsen-Hamilton (September 1993)

14) *Down regulation of gene expression by antisense and other technologies* – Richard Gladon and Cecil Stewart (September 1993)

15) *Monoclonal Antibody Production Techniques* course (B/B511D – Kristi Harkins (Fall 1994)

16) *Conference on virulence mechanisms of bacterial pathogens* – James Roth (June 1994)

17) Introduction to the Instrumentation Facilities for Biotechnology Research (Zoo/Gen 542X – Kristi Harkins (Spring 1994)

18) *Intracellular signaling from Ras to Genes* – Marit Nilsen-Hamilton (September 1994)
Rose rosette and other eriophid mite-transmitted plant pathogens of uncertain etiology – A. H. Epstein (May 1994)

19) *Future Genetics for the Animal Industry* – A.E. Freeman (May 1994)

20) *Signal Transduction in Plants* – IPPM Symposium—Martin Spalding (March 1995)

21) Symposium for recruiting domestic students and promoting collaborations – Marit Nilsen-Hamilton (March 1995)

22) *Growth Factor and Signal Transduction Symposium* – Marit Nilsen-Hamilton (September 1995)

23) *Interferon Symposium* – Marit Nilsen-Hamilton (June 1996)

24) *High School Recruitment Via Distance Education* – Douglas Bull (January 1997)

25) *Nuclear-Cytoplasmic Interactions Mini-Symposium* – Martin Spalding (March 1997)

26) *EGF Receptor Symposium* – Marit Nilsen-Hamilton (September 1997)

27) *Biochemical and Molecular Regulation of Carbohydrate Metabolism* – Martin Spalding (March 1998)

28) *Endocytosis and Intracellular Trafficking* – Marit Nilsen-Hamilton (September 1998)

29) *Themes in Plant Development* – Martin Spalding (March 1999)

30) *Metabolic Networking in Plants Symposium* – Eve Wurtele and Parag Chitnis (April 1999)

31) *Genetics Vision Symposium* – Max Rothschild and Susan Lamont (May 1999)

32) *Virulence Mechanisms of Bacterial Pathogens* – James Roth (September 1999)

33) *Plant Derived Biologics* – James Roth (April 2000)

34) *22nd Midwest Neurobiology Meeting* – Donald Sakaguchi (May 2000)

35) *Plant Biochemistry and Molecular Biology Symposium* – Paul Scott (June 2000)

36) *Biologics for Cancer Diagnosis, Prevention and Immunotherapy* – James Roth (April 2001)

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37) *Symposium on Post-Transcriptional Control of Gene Expression in Plants* – Marit Nilsen-Hamilton and Allen Miller (May 2001)

38) *Mini-Symposium on "Seed Physiology"* – David Hannapel (March 2001)

39) *Plant Hormone Perception and Signaling* – David Hannapel (March 2002)

40) *Detecting and Controlling BVDV Infections* – James Roth (April 2002)

41) *Iowa State University/University of Iowa Joint Bioinformatics Workshop* – Hal Stern (April 2002)

42) *Third Annual Plant Sciences Institute Symposium on Proteomes: Structure, Changes, Interactions, and Function* – Marit Nilsen-Hamilton (September 2002)

43) *Twelfth Annual Growth Factor and Signal Transduction Conference on Molecular Targets for Dietary Intervention in Disease* – Marit Nilsen-Hamilton (September 2002)

44) *Symposium on "Tissue Remodeling"* – Marit Nilsen-Hamilton (August 2002-postponed from Sept. 2001 because of World Trade Center bombings)

45) *Bioethics Winter Retreat* – Kristen Hessler (January 2003)

46) *Mini-Symposium on "Plant Adaptations to Environmental Stress"* – David Hannapel (March 2003)

47) *John M. Airy Beef Cattle Symposium* – James Reecy (May 2003)

48) *24th Midwest Neurobiology Meeting* – Donald Sakaguchi (May 2003)

49) *Breeding for Disease Resistance-Uniting Genetics and Epidemiology* – Susan Lamont (May 2003)

50) *Plant Sciences Institute Symposium on "Transposition, Recombination, and Application to Plant Genomics* – Marit Nilsen-Hamilton (June 2003)

51) *Midwest Theoretical Chemistry Conference* – Mark Gordon (June 2003)

52) *Stem Cell Biology: Development and Plasticity* – Marit Nilsen-Hamilton (September 2003)

53) *Recent Advances in Biotic Stress, mini-symposium* – Robert Thornburg (April 2004)

54) *Technology and Approaches to Reduce, Refine and Replace Animal Testing* – James Roth (April 2004)

55) *Third Biennial All Iowa Virology Symposium* – Bryony Bonning (October 2004)

56) *Plant Sciences Institute Symposium on Meristems 2005* – David Hannapel (June 2005)

57) *GFST Conference on Integration of Structural and Functional Genomics* – Christopher Tuggle (September 2005)

58) *Symposium: Genetics of Animal Health 2005* – Susan Lamont (July 2005)

59) *New Facets in Cross-Kingdom Interdependence: Molecular Plant-Microbe Interactions* – Robert Thornburg, Kan Wang (March 27-28, 2006)

60) *Growth Factor and Signal Transduction Symposium on Lipocalins in Health and Disease* – Marit Nilsen-Hamilton, et. al (September 14-17, 2005)

61) *Plant Sciences Institute Symposium on Plant Receptor Signaling* – Phil Becraft, et. al (June 22-26, 2005)

62) *2006 Bioinformatics Symposium* – Dan Voytas, Robert Jernigan (July 13-15, 2006

63) *The Virulence Mechanisms of Bacterial Pathogens International Symposium* – Kim Brogden, et. al (September 6-8, 2006)

64) *Plant Sciences Institute Symposium on Epistasis: Predicting Phenotypes and Evolutionary Trajectories* – Marit Nilsen-Hamilton, et. al (May 31-June 3, 2007)

65) *Growth Factor and Signal Transduction Symposium on Senescence, Aging and Cancer* – Marit Nilsen-Hamilton, et. al (July 26-29, 2007)

66) *9th International Pollination Symposium on Plant-Pollinator Relationships* – Harry Horner, et. al (June 24-28, 2007)

67) *Loomis Lecture and IPPM Mini-Symposium on Long Distance Signaling* – Kan Wang, et. al (April 2-3, 2007)

68) *Advanced Food for Health Symposium Series: Resistant/Slowly-Digestible Starch* – Martha James, et. al (May 7-9, 2007)

69) *Fifth Biennial All Iowa Virology Symposium* – Bryony Bonning, Cathy Miller (September 19-20, 2008)

70) *Loomis Lecture and IPPM Mini-Symposium on "Organelle Biogenesis and Protein Targeting* – Kan Wang, Diane Bassham, and David Hannapel (March 27-28, 2008)

71) *GFST Symposium on "Extracellular and Membrane Proteases in Cell Signaling*" – Marit Nilsen-Hamilton (September 18-21, 2008)

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72) *Nutrition and Wellness Research Center Annual Symposium on "Gut Health: Mechanisms of Diet, Microbes and Immunity*" – Suzanne Hendrich, Diane Birt, Ruth MacDonald, and Mike Wannemuehler (May 7-9, 2008)

73) *Workshop on Translational Biology* – Carolyn Lawrence and Steve Rodermel (October 27-29, 2008)

74) *GFST Symposium on Systems Biology: Integrative, Comparative, and Multi-Scale Modeling* – Marit Nilsen-Hamilton (June 11-14, 2009)

75) *Second ISU Aphid Research Symposium* – Bryony Bonning and Matt O'Neal (January 16, 2009)

76) *Loomis Lecture and IPB Mini-Symposium on "Plant-Insect Interactions"* – Kan Wang, Gustavo Macintosh, and Simi Venkatagiri (April 27-28, 2009)

77) *NWRC Annual Symposium on "Vaccines, Immunity and Well-Being* – Suzanne Hendrich, Marian Kohut, Daniel Russell, and Michael Spurlock (May 17-19, 2009)

Biotechnology Information Series
North Central Regional Extension Publications

In order by publication date

Principles of Biotechnology – March 1994, Revised June 1998
Written by David F. Betsch, Ph.D., Biotechnology Training Programs, Inc. Edited by Glenda D. Webber, Iowa State University Office of Biotechnology

Bovine Somatotropin – March 1994
Written by Nolan R. Hartwig, D.V.M. Iowa State University Extension Veterinarian, and Glenda D. Webber, Office of Biotechnology, Iowa State University

Careers in Biotechnology – March 1994
Written by Glenda D. Webber, Iowa State University Office of Biotechnology

Plant Disease Diagnostics – March 1994
Written by Paula H. Flynn, extension associate, Iowa State University. Edited by Glenda D. Webber, Iowa State University, Office of Biotechnology

Porcine Somatotropin – June 1994
Written by Palmer J. Holden, Iowa State University Animal Science Extension. Edited by Glenda D. Webber, Office of Biotechnology

DNA Fingerprinting in Human Health and Society – November 1994
Written by David F. Betsch, Ph.D., Biotechnology Training Programs, Inc. Edited by Glenda D. Webber, Iowa State University Office of Biotechnology

DNA Fingerprinting in Agricultural Genetics Programs – November 1994, Revised April 1999
Written by David F. Betsch, Ph.D., Biotechnology Training Programs, Inc. Edited by Glenda D. Webber, Iowa State University Office of Biotechnology

Genetically Engineered Fruits and Vegetables – November 1994
Written by Glenda D. Webber, Office of Biotechnology, Iowa State University, Ames, Iowa

Insect-Resistant Crops through Genetic Engineering – January 1995
Written by Glenda D. Webber, Office of Biotechnology, Iowa State University

Regulation of Genetically Engineered Organisms and Products – January 1995
Written by Glenda D. Webber, Office of Biotechnology, Iowa State University, Ames, Iowa

Pharmaceutical Production from Transgenic Animals – February 1995
Written by David F. Betsch, Ph.D., Biotechnology Training Programs, Inc. Edited by Glenda D. Webber, Iowa State University Office of Biotechnology

Appendix 12.6

Biotechnology Curriculum Units

In order by publication date

A Crime, A Clue and Biotechnology – May 1996
Prepared by Kate Carinder, Debbie Curry, Sue Delaney, Dennis DeWitt, Cheryl Heronemus, Dennis Johnson, Sheilah Manley, Kathie Oberman, Earl McAlexander, Barbara Sauser, Dave Seilstad, Mark Torché, Walter Fehr, Thomas Ingebritsen, Lori Miller, Melva L. Berkland, Jessica J. Lamker

Biotechnology School Enrichment Grades 5-6 – October 1997
Prepared by Debbie Curry, Sue Delaney, Dennis DeWitt, Teresa Findley, Ryan Groen, Mitchell Hoyer, Saqib Mukhtar, Kathie Oberman, Earl McAlexander, Barbara Sauser, David Seilstad, Walter Fehr, Lori Miller, Melva L. Berkland, Jolene McCoy

Biotechnology School Enrichment Grades 7-8 – October 1997
Prepared by Debbie Curry, Sue Delaney, Dennis DeWitt, Teresa Findley, Ryan Groen, Mitchell Hoyer, Saqib Mukhtar, Kathie Oberman, Earl McAlexander, Barbara Sauser, David Seilstad, Walter Fehr, Lori Miller, Melva L. Berkland, Jolene McCoy

Microscopes and Cells: Biotechnology School Enrichment Grades 4-5 – July 1998
Prepared by Debbie Curry, Jodi Mills, Sue Delaney, Dennis DeWitt, Teresa Findley, Josh Riphagen, Mitchell Hoyer, Saqib Mukhtar, Kathie Oberman, Earl McAlexander, Barbara Sauser, David Seilstad, Walter Fehr, Lori Miller, Melva L. Berkland, Jolene McCoy, Lonna Nachtigal

Cut the Fat, Keep the Flavor: Resource Unit About the Role of Agricultural Genetics in Reducing Saturated Fat in Food Oils – April 1999
Prepared by Melva L. Berkland, Debbie Curry, Walter Fehr, Lori Miller, Jodi Mills, Glenda Webber, Kim Burnett, Elinor Fehr, Andrea Frederickson, Deana Hildebrand, Marlene Scott

A Better-Tasting and More Digestible Soybean: Agricultural Genetics Resource Unit for Grades 9-12 – August 2001
Prepared by Michael Zeller, Glenda Webber, Sue Delaney, Dennis DeWitt, Walter Fehr, Karen Gebel, Mitch Hoyer, Barbara Hug, Earl McAlexander, Diane Nelson, Kathie Oberman, John Robyt, Barbara Sauser, David Seilstad, Jay Staker, Steven Truby

Bacillus thuringiensis: Sharing Its Natural Talent with Crops – January 2003
Prepared by Glenda Webber, Michael Zeller, Kristen Hessler, Walter Fehr, Robert Martin, Jay Staker, Arlene D'Souza

From Mendel to Markers: Impact of Molecular Technologies on Animal, Plant, and Human Genetics – August 2005
Prepared by Michael Zeller, Kristen Hessler, Glenda Webber, Walter Fehr, Marcus E. Kehrli, Jr., Robert Martin, Kim Oltrogge, Jay Staker

EQUIPMENT AND SUPPLIES FOR DNA LABORATORY EXERCISES

1 - 48 quart styrofoam cooler
1 - Heat lamp with reflector
1 - 100-watt clear light bulb
1 - Box of aluminum foil
8 - Sharpie extra fine point permanent marker
2 - Test tube racks
72 - 13 x 100 mm glass test tubes and caps
32 - Stirring rods
1 - Bottle of Adolph's meat tenderizer containing papain
1 - Box of flat toothpicks
16 - Styrofoam 16 oz. glasses
1 - Thermometer (-20 to 110^0 C)
2 - 1,000 ml graduated bottles w/cap
64 - Pasteur pipettes
16 - Rubber bulbs for pasteur pipettes
1 - Box of large smooth paper clips
40 - 1.5 ml microcentrifuge tubes
2 - Microcentrifuge tube racks
80 - Petri dishes (4 sleeves)
1 - 22 oz. bottle of Dawn dishwashing liquid
2 - Empty 125 ml graduated bottles w/cap
1 - 0.75 g CaCl2 in a 125 ml graduated bottle w/cap
1 - 30 g of Agar in a 4 oz. plastic bottle
*1 - 0.05 g dry ampicillin in microcentrifuge in a manilla envelope
*1 - 1.2 ml of 0.005 ug/ul plasmid DNA, pBR322
1 - Small insulated thermos
1 - Test tube brush
8 - Paper dixie cups for meat tenderizer & toothpicks
1 - Oven mitt
1 - 500 ml bottle w/cap
1 - Hot plate
1 - 9x9 square metal baking pan
1 - 70 g. of LB premix in a 4 oz. plastic bottle
1 - 125 ml of 95% denatured ethanol in a 4 oz. plastic bottle
**1 - Slant culture of E.coli, strain MM294

*Keep frozen until used.
**Store in refrigerator at 5 - 10^{0}C. Do not freeze.

"The Nature of Change" videotape provided by Monsanto Company.
Sample box of Humulin R insulin provided by Eli Lilly Company.

The equipment and supplies provided in this DNA kit are provided with the compliments of the Office of Biotechnology and the Cooperative Extension Service of Iowa State University through grants from:

The Roy J. Carver Charitable Trust
Iowa Farm Bureau
Iowa Soybean Promotion Board
Penford Products Company
Monsanto Company
Pioneer Hi-Bred International, Inc.
West Central Cooperative
Pitman-Moore Company

Appendix 12.8

ELECTROPHORESIS KIT SUPPLY LIST

2 electrophoresis gel boxes (with 3 combs) (in boxes)

1 power supply (in box)

6 pipettors

2 plastic rubbermaid containers

1 1000ml graduated bottle (in box)

1 250ml erlenmeyer flask (in box)

1 100ml graduated cylinder

1 1000ml graduated cylinder

1 4" plastic funnel

1 clear piece of plexiglass

Laboratory Protocols and Activities

Free laboratory supplies and/or instructional materials for 27 laboratory protocols are available to Iowa educators for the 2009-2010 school year. Teachers receive the supplies by parcel service or mail, postage paid. Instructional materials can be downloaded free from www.biotech.iastate.edu/publications/ed_resources/Laboratory_protocols.html.

Free lab supplies and instructional materials are available for:

- Bt corn vs. the European corn borer
- Chymosin demonstration
- DNA extraction – bacteria
- DNA fingerprinting
- DNA transformation of bacteria
  - ampicillin resistant
  - recombinant DNA: dual antibiotic-resistance genes
  - red colony
- Evolution of antibiotic resistant bacteria
- Marker assisted selection of the K-casein allele
- Micropropagation of plants
- Plasmid isolation and analysis - red colony
- QuickStix™ strip tests
  - corn leaf tissue
  - corn seed
  - Roundup® Ready® soybeans
- Soybean flavor demonstration
- Soy drink
- Using invertase to detect sucrose in soybeans
- Using thin-layer chromatography to detect sucrose in soybeans

Instructional materials are available for:

- Bioethics activity: golden rice case study
- DNA extraction
  - kiwi
  - onion
  - fruit cup
  - DNA in My Food? – The Making of a Smoothie
- Pipettor practice – submitted by Jen Koenen, Hampton-Dumont High School
- Polymerase chain reaction (PCR)
  - activity
  - simulation in PowerPoint®
  - simulation in QuickTime® movie