

# Needs Assessment for Florida's Biotechnology Industry

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Prepared for



Prepared by

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**EMPLOY FLORIDA**  
**BANNER** Center  
**Biotechnology**

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## Summary

Industrial biotechnology is poised for expansion in Florida as the existing infrastructure of cutting edge university research combined with technology transfer programs and incubators for start-up companies, merge with new state initiatives to build a high-tech/high-skill/high-wage corridor for this nationally growing industry. As a highly regulated industry, workers must be technically knowledgeable and understand how to work in a regulated environment.

The Employ Florida BANNER Center for Biotechnology has identified 130 companies as “biotechnology-based,” which have appeared in clusters primarily in the south-east area, Tampa Bay area, and north-central Florida. These companies encompass seven classifications based on their products and/or services, with the majority of them (47%) being classified as Pharmaceutical/Biopharmaceutical. The 130 identified companies directly employ 7,850 people, with the majority of employees (53%) falling under the classification for the development and production of pharmaceutical medicine. Employees in biological devices make up 25% of the employee pool, with the remaining 25% falling under research and development.

Many of Florida’s existing biotechnology-based companies are in the “start-up” and “growth phase,” (40% combined), and annual projected growth in number of employees is expected to be 9.4% over the next five years, generating 3,750 biotechnology-based careers. This growth is expected to accelerate due to the establishment of Scripps, the Burnham Institute, Torrey Pines, and their associated spin-off companies. A critical factor in the industry growth is the availability of skilled workers. These employees need knowledge and skill sets specific to industrial biotechnology, that are not typically taught in colleges as part of traditional academic programs.

Florida boasts six community colleges with biotechnology training programs, as well as four four-year institutions awarding B.S. degrees in the field, and two institutions offering advanced degrees. In addition, a high school curriculum has recently been accepted by the state that will prepare students to join the workforce at an entry-level, or articulate into community college biotechnology programs. There are many specific skill-sets in the field of biotechnology however, that make it difficult for any one program to be comprehensive.

The most common skills and knowledge bases identified by industry as being most in demand include hands-on experience with production and laboratory equipment, the use and application of computers, being able to work in a controlled environment, including cleanrooms, how to work in compliance with GMP regulations, following Standard Operating Procedures, concepts and skills in Quality Assurance and Quality Control, and an understanding of the regulations of the industry.

Short (2-4 day) training programs are of most value to the industry, and are preferred over longer courses (BANNER Center survey data, presented in Appedix E). Hands-on training is preferred, as it is risky, expensive, and time consuming for companies to

allow new employees hands-on practice without close supervision, and it takes time for new employees to subscribe to the mind-set that is required for regulatory compliance. Additionally, courses offered in specific techniques and applications allow for advanced training for current employees.

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## Introduction

Biotechnology is defined as the technological application of biological systems, living organisms, or their derivatives, to make or modify products or processes. One of the fastest growing biotechnology-based product classes is biopharmaceuticals, which encompasses proteins, cells, small molecules and genes with therapeutic or diagnostic value. Biotechnology however encompasses a broad spectrum of commodities and services that fall under the umbrella “biomanufacturing.” Biomanufacturing involves the controlled production of biotechnological or biomedical products including biopharmaceuticals; diagnostic test materials; enzymes, antibodies, and other protein products; transgenic plants and animals; and biomedical implants and devices.

### **Biomanufacturing and Related Industry Groups**

Based on a 2006 survey conducted by Enterprise-Florida, there are 99 companies that have been categorized, or are in the process of being categorized as “biotechnology” in the state of Florida. In addition, the Employ Florida BANNER Center for Biotechnology has identified 31 additional companies, for a total of 130 (Appendix A). The grouping includes small, start-up companies who are primarily involved in research and development, as well as more established companies engaged in biomanufacturing and the sale of products. Also included are medical device companies that use biologic material in their products. Companies that only have business offices and no research and development, or manufacturing facilities were not included on the list of 130 companies.

As start-up biotechnology companies mature and transition from research and development to manufacturing and sale of their products, they become further defined by the regulations and manufacturing processes that they employ, and by their products and business markets.

Industrial Biotechnology includes the biopharmaceutical, agricultural biotechnology, diagnostics, and medical device sectors that are developing and manufacturing products. To further define biotechnology-based industries, we assigned each organization to one of the following seven classifications:

### **Industry Classification**

1. **BioPharmaceutical:** Companies that develop or manufacture therapeutic biological pharmaceuticals, including regenerative and stem cell-based products. Examples include: Applied Genetic Technologies Corporation (AGTC), AxoGen and Morphogenesis Incorporated. AGTC is a biopharmaceutical company that uses viral vectors for gene therapy. AxoGen provides surgeons a biological solution to repair and regenerate peripheral nerves with a processing compound that fosters nerve regeneration. Morphogenesis Inc. is an emerging biotechnology company focusing on cell therapy products to treat chronic disorders by using stem cells.

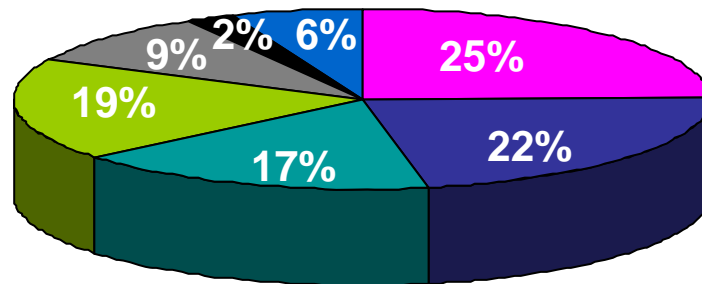
2. **Pharmaceutical:** Companies that develop or manufacture non-therapeutic pharmaceutical products such as Nanotherapeutics, which is an emerging pharmaceutical company that manipulates and enhances the properties of drugs. Additional examples include Alfa Laboratories Inc., which manufactures vitamins, and Watson Pharma, which conducts solid dosage manufacturing with a focus on research and development of generic pharmaceuticals.
3. **BioProduct:** Companies that develop or manufacture biological products, including but not limited to; enzymes, antibodies, and bacteria. Example companies include: One Biotechnology Co., which furnishes bioproducts to the plumbing and septic industry. EnCor Biotechnology Inc., which manufactures and markets monoclonal and polyclonal antibodies to commercial vendors and researchers.
4. **Diagnostic:** Companies that utilize biotechniques to perform or manufacture diagnostic assays for the detection/identification of genetic material, microbes, or diseases. Example companies include: DNAPrint Genomics Inc., which develops products and services in the areas of pharmacogenomics, forensics, genotyping, and other consumer products, and Banyan Biomarkers which is developing vitro diagnostic products to address unmet clinical needs for the detection of traumatic brain injury.
5. **Device:** Companies that develop or manufacture implants or surgical devices; specifically biological devices or synthetic devices with regenerative properties. Example companies include Regeneration Technologies Inc., which manufactures allografts and holds the patent on BioCleanse, a tissue sterilization process, and Medtronic ENT, which has developed MeroGel Injectable, a bioresorbable nasal dressing and sinus stent.
6. **Agriculture/Marine Biotechnology:** Companies that utilize biotechnology to improve the production/quality of materials pertaining to Agriculture or Marine. Example companies include Integrated Plant Genetics Inc., which uses transgenic biotechnologies to develop, produce and license new plants for the purposes of microbial, horticultural, agricultural and forestry improvement, and Oglesby Plants International, which specializes in the micropropagation of tropical foliage and offers a number of tissue culture related services.
7. **Bioinformatics:** Companies that develop and market biological software or provide biological informational services. Examples companies are Hybercube, which is a scientific software company that develops a molecular modeling program, and Firebird Biomolecular, which supplies nucleic acid components, libraries, polymerases, and software to support human diagnostics, synthetic biology, and human therapy.

### Breakdown of Industrial Biotechnology by Classification

Of the 130 companies statewide, the majority of companies fall under the biopharmaceutical (32 total, or 25%) and pharmaceutical (29 total, 22%) classifications, for a combined 47% of the total biotechnology-based industry in Florida. According to the 2004 Milken Report on “Biopharmaceutical Industry Contributions to State and U.S. Economics,” the Department of Labor ranks biopharmaceutical manufacturing among the fastest-growing manufacturing industries in the nation, and it is projected that demand for biopharmaceuticals will remain strong regardless of fluctuations in the economy. Despite the diversity of products and services that these companies produce, there are similarities in the technologies, skills and knowledge-base.

**Figure 1**  
**Breakdown of Industrial Biotechnology by Classification**

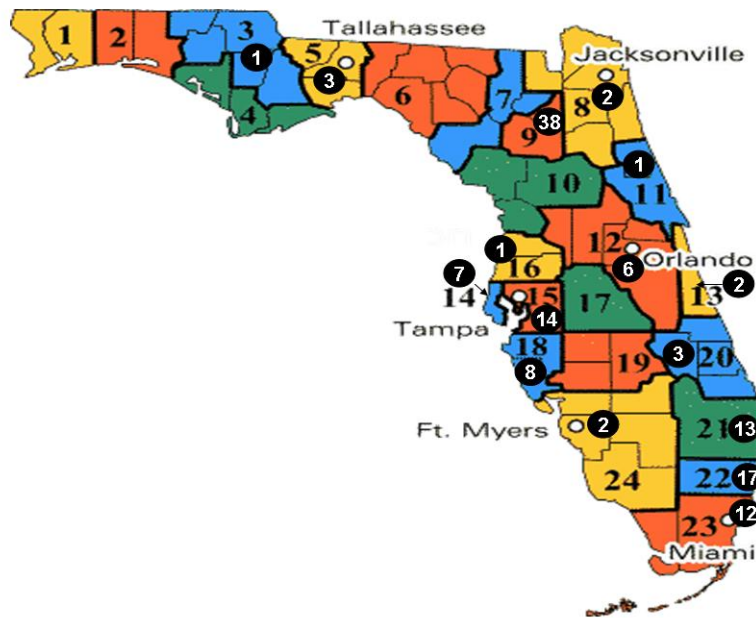
- BioPharmceutical: 32
- Pharmaceutical: 29
- BioProduct: 22
- Diagnostic: 24
- Device: 12
- Bioinformatics: 3
- Agriculture/Marine Biotechnology: 8



### Distribution of Industrial Biotechnology Companies

The majority of the identified companies are clustered around large cities and/or major Universities. Three large cluster areas are the Tampa Bay area (Pinellas, Hillsborough, Manatee, Pasco, Sarasota counties), Southeast area (Palm Beach, Broward, Miami-Dade counties), and north central (Alachua county). Central Florida is growing and with the addition of the UCF’s medical school and the Technology Incubator, this area should continue to expand. Below is a map (figure 2) of Florida identifying regional workforce boards and the number of companies in that region highlighted by a black circle.

**Figure 2**  
**Distribution of Industrial Biotechnology Companies**



### Profile of the Industrial Biotechnology Workforce

The current number of employees in Florida’s industrial biotechnology workforce was approximated by utilizing the 2005 North American Industry Classification System (NAICS) data maintained by the U.S. Department of Labor, Bureau and Labor Statistics (Appendix B), and data from the 2004 Milken Study (Appendix C). “Biotechnology” as an industry has not been assigned an NAICS number, so for this assessment we identified the NAICS number for each of our seven classifications (See “Industry Classification”) and determined the sum of employees. The majority of our companies fell under the NAICS code for *Pharmaceutical and Medicine Manufacturing* (code #3254, subsets 11-14), with a combined total of 4136 employees. The companies that met our criteria for “Device” (incorporating a therapeutic) are a small subset of the NAICS code for *Medical Devices* (code #3391, subset 13), so we calculated the number of employees in this subset by the surveying the companies individually, with the six major companies (Regeneration Technologies Inc., Medtronic, Tutagen, Exactec, GMP, 3i, and Awareness Technologies) reporting a combined total of 1762 employees. To capture the number of employees working in start-up companies that are in the research and development stage, we used data from the 2004 Milken study, which identified 1,949 employees in research and development. In total, we approximate that there are 7,850 individuals currently in the state of Florida who are employed in industrial biotechnology.



## **Trends Affecting Biotechnology Workforce Development**

New statewide initiatives have been implemented to expand Florida's biotechnology industry. Along with this expansion is the need to fill technical positions with trained and qualified workers.

In 2002, the Governor of Florida established an initiative to diversify the economy of Florida that is heavily dependent on tourism and agriculture, with the Center of Excellence Initiative. The University of Florida's Center of Excellence for Regenerative Health Biotechnology (CERHB) stemmed from this initiative, with the mission to stimulate promising research and facilitate commercialization of technologies that will provide treatments for human diseases, as well as create new companies and high-wage jobs. CERHB has three initiatives to facilitate this mission: 1) expand clinical biopharmaceutical manufacturing infrastructure, 2) stimulate workforce training programs in biomanufacturing, quality assurance/quality control, and regulatory affairs, and 3) foster regenerative health research. The initiative plays an integral role in developing the biotechnology cluster in Florida by stimulating new company formation, existing company expansion, and attracting outside companies to the region.

In 2003, the Governor announced an investment of \$310 million from the State and an additional \$200 million from Palm Beach County to establish Scripps Research Institute Florida. This initiative is expected to employ 545 full time faculty and staff, and eventually create 200 new businesses and 16,000 new jobs.

To date, Scripps is estimated to have created 1,288 jobs statewide since arriving in Florida, of which 195 are direct operational and 205 are facility related. Additional jobs created were the result of either indirect, operating inputs by local area businesses, or induced, local and state activity from expenditures by Scripps. Scripps total income impact for its third full year has been over \$52 million, including all direct, indirect, and induced income. In a report to the Florida legislature, former governor Bush reported that Scripps will help create 2,741 in Florida in the next seven years. That number will increase to 6,466 in 15 years with a "biotech cluster strong enough to create an additional 44,293 jobs, bringing the total impact of the Scripps presence in Florida to 50,759 new jobs." This data was obtained from eFlorida's "The Economic Impact of Scripps Florida on Florida's Economy, October 1, 2005 to September 30, 2006." It is important to note however, that this is a summation of all jobs created, and not strictly those requiring skills in biotechnology.

Florida's Biotechnology initiative has also attracted Torrey Pines Institute for Molecular Studies to Port St. Lucie and the Burnham Institute to Orlando. Burnham will create 300 jobs and Torrey Pines another 189 jobs within their own facilities.

It was reported in the January 2007 issue of Florida Trend magazine that as a result of the Scripps initiative, seven of the top ten prospects that Palm Beach County's economic development group are communicating with are "significant life sciences

companies,” according to Business Development Board President Kelly Smallridge. In the same issue, Chuck Soponis, CEO of Nanotherapeutics, said that Scripps has opened the door to private funding for Florida companies, by creating business clusters which appeal to venture capitalists.

### **Projected Growth in 2007:**

#### **Scripps Research Institute**

- Break ground at Florida Atlantic University’s Jupiter campus
- Three buildings are scheduled to open in 2009.
- Have 247 to 267 employees at Scripps by end of year
- State and local investment: \$650 million

#### **Burnham Institute for Medical Research**

- Will take up temporary quarters at Florida’s Blood Centers in Orlando
- Hire 30 scientists and technicians.
- Break ground on its Lake Nona site this year.
- State and local investment: \$310 million
- 300 new jobs over seven to ten years

#### **Torrey Pines Institute for Molecular Studies**

- Will take up temporary quarters at Harbor Branch Oceanographic Institution
- Hire 15 to 20 people by end of year
- Have 25 to 30 by the end of 2008.
- Break ground in March on a new headquarters.
- 189 new jobs over ten years
- State and local investment: About \$100 million

#### **SRI International**

- Opens its new marine technology research facility in St. Petersburg,
- Staffed by 40 researchers from USF’s Center for Ocean Technology.
- A permanent research facility will come on line in 18 months.
- State and local investment: \$47.5 million

*Data from Florida Trend magazine January 2007*

### **Incubators/Research Parks**

To foster the success of start-up biotechnology-based firms that originate from innovations developed in the research institutions, Florida has developed Technology Incubators and Research Parks. Although not all of the incubators offer Biotechnology specific services or research space, they all offer offices and a source of business information. The Research Parks are located throughout Florida and many host the Technology Incubators. Most of the Parks are in constant growth, with Central Florida

Research Park and the Progress Corporate Park being an example of long established parks.

**University of Florida's Sid Martin Biotechnology Incubator** has set the standard for Technology Incubators, in operation for 11 years and as has hosted 34 tenants, with 11 current companies. With its flexible pricing structure, operation support service, and over \$1 million of on site equipment it gives biotech start-ups the chance to succeed. It is the hub of the 204-acre **Progress Corporate Park** which has additional space, including a new 32,000 square foot building under construction, allowing companies to grow once they graduate from the Incubator. The Employ BANNER Center for Biotechnology is located in Progress Corporate Park near the Sid Martin Biotechnology Incubator.

The **Tampa Bay Technology Incubator** is a 60,000 square foot facility that will include office and laboratory space designed for biotechnology and life sciences research. The Incubator is housed in one of the two research buildings at **USF Research Park**. The \$40 million Park has 230,000 square feet total space and is the first step of USF's plan to develop its 87-acre research park. The Park offers core and shared laboratories and houses Center for Biological Defense.

The **University of Central Florida's Technology Incubator** offers services geared toward the earliest stages of company formation. The Bennett Complex, the Incubators Innovation & Commercialization Center, provides flexible space for incubator clients that need larger facilities or that need space suitable for laboratory or production activities. The Incubator is located in the **Central Florida Research Park**, which is a 1,027 Acre Office Park that has 48 buildings, 106 companies and approximately 9,500 Employees with more than 400 UCF students/graduates employed in the Park. Not all of the companies are in the Biotechnology field but some do offer support for researching activities.

**Florida Atlantic University's Technology Business Incubator (TBI)** purpose is to foster the start-up and growth of technology-based businesses. Four 50,000 square foot buildings are designed to accommodate office space, light assembly and manufacture, service and research activities, they provide flexible office space for firms desiring to locate into the FAU Research Park. **The Florida Atlantic Research and Development Park** is a 52-acre research park located on FAU's Boca Raton Campus with a similar facility in Deerfield Beach.

**Florida Gulf Coast Technology and Research Park** offers prime technology, office and research space for innovative high-tech companies while serving as a base for cutting edge research, public-private collaboration and opportunities for students. The Research Part houses 650,000 square feet of prime office, technology, research, and laboratory space.

**Innovation Park**, located in Tallahassee, is a university related research park combining the resources of Florida A&M University and Florida State University to

attract private industry. The Park is located on 208 Acres in southwest Leon County, 14 buildings completed totaling 800,000 square feet, with 30 organizations, and employing 1,500 people. The companies at the Park represent a mix of private industry, higher education, and government, and do not primarily focus on Biotechnology related tenants.

**St. Lucie Research and Education Park** covers 1,600 acre and is presently occupied by the state-of-the-art USDA-ARS National Horticulture Laboratory, the University of Florida Indian River Research and Education Center, the USDA-NRCS Office, and County Cooperative Extension Service. The master plan for the Research Park calls for over 800 developed acres to house the education and the development of components, and 850 acres for agriculture fields and for future growth. While the parks primary focus is in agriculture, there are local biotechnology companies that benefit from the proximity.

These initiatives as outlined above will continue to generate jobs that require a qualified and dedicated workforce. Currently, there is a shortage of trained workers in Florida, which will limit the attractiveness of biopharmaceutical and pharmaceutical companies to relocate or establish. According the 2004 Milken Study 10-year Industry Projection, Florida will expand employment in the biopharmaceutical industry by 4,500 jobs. Additionally, the forecast indicates that Florida is outpacing the national industry share in biotechnology, indicating that the state is performing and growing in that sector better than most states.

## **Survey of Industry Needs and Job Growth in Biotechnology**

It is important to note that there is an overlap between companies deemed strictly “biotechnology,” based on their production processes and products, and companies that utilize the technologies, principles, and regulations common to biotechnology, yet are not defined as biomanufacturers. For this needs assessment, we include organizations such as the manufacturers of small-molecule pharmaceuticals, whose employees require a similar knowledge base and skills. We also include Scripps Florida, Torrey Pines Institute of Molecular Research, and the Burnham Institute due to their projected hiring needs and influence on industry growth, and their associated spin-off companies. This report encompasses scientific and technical employees representing the spectrum of biotechnology-based organizations, who require a background in science and regulatory compliance, or training specific to the technologies and methodologies that are used in the biotechnology industry.

## **Survey as an Assessment Tool**

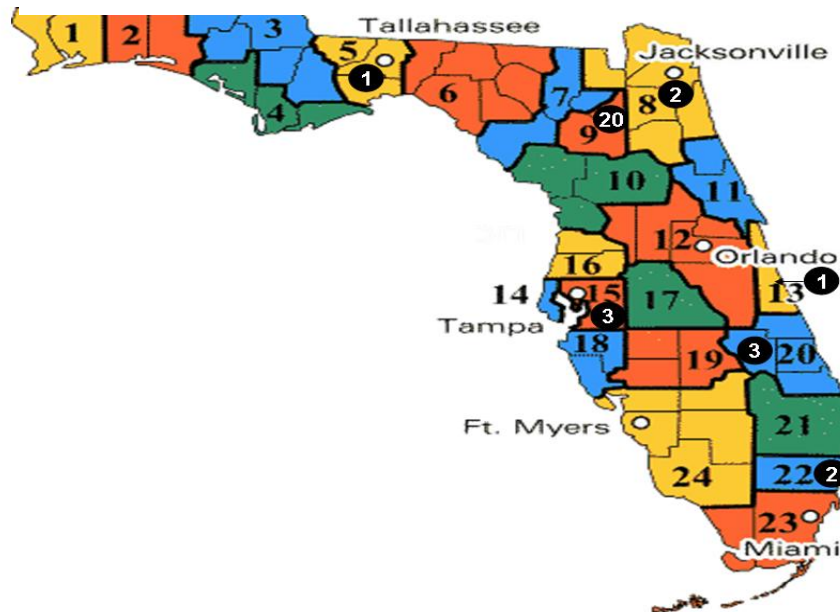
Our survey was designed as an instrument to assess several parameters influencing current and projected training needs for a sustainable workforce (Appendix C). The overall “maturity” of the industry within the state is one critical factor. As biotechnology

companies transition discoveries made in the research laboratory into products, their workforce skill requirements change. To determine which positions will be in the highest demand, industry representatives were asked to project the estimated number of new-hires for the next one-year and five-year time periods specific to areas of employment and skill-level. Additionally, survey participants identified skill-sets in which their current employees need additional training. See Appendices D and E for survey data.

### Survey Population and Administration

The survey was administered to the Biotechnology-based companies included on the list maintained by the Employ Florida Biotechnology BANNER Center. The primary means of contact and survey administration was by telephone, targeting the departments of Human Resources. In some cases, companies noted that they would only respond to e-mail or hard copies of the survey. Of the companies surveyed, we received 36 completions resulting in a return rate of approximately 28%. State representation was inclusive of the three major cluster areas (Tampa Bay, Southeast, and North Central). Following is a map (figure 3) indicating the number and location of responding company sites (number in black circles).

**Distribution of Survey Responses across the State**  
**Figure 3**



## Survey Group Maturity

Survey participants were asked to assign a developmental stage to their company given the choices of: 1) Start-up, 2) Growth, 3) Commercial, or 4) Other. Start-up companies are defined as the early stages of development, with funding primarily from grant or angel sources. The Growth phase is the transition from a primarily research and development base to product development, with funding coming from venture capital. Commercial phase is the full development and launch of a commercially available product. We included the “Other” category because of the inclusion of Scripps, Torrey Pines, The Burnham Institute and the Florida Department of Health (Bureau of Laboratories) in the survey. Our survey results indicate that currently most Florida biotechnology-based companies are in the start-up and growth stages (figure 4).

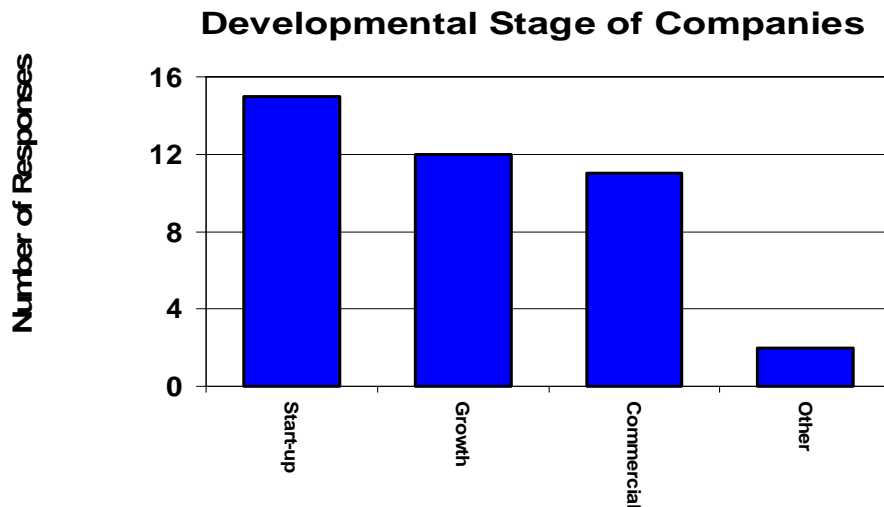


Figure 4: We asked companies to classify themselves as either start-up, growth, commercial, or other. Some companies responded to one or more categories. We counted all of the responses, so some companies are counted more than once. Burnham Institute responded in the other category as non-profit biomedical research and the Bureau of Laboratories as clinical testing.

## Employee Profile

Survey participants were asked to give a breakdown of the education level of their employees, to give an indication of what level of education is currently being most utilized. Employees with Bachelor’s degrees make up the highest percent (34%) of the total responses, followed by a technical certificate (23%), Ph.D. (18%), Masters and Associates degrees (10% each), and High School diploma (6%). See figure 5.

## Current Employee Education Level

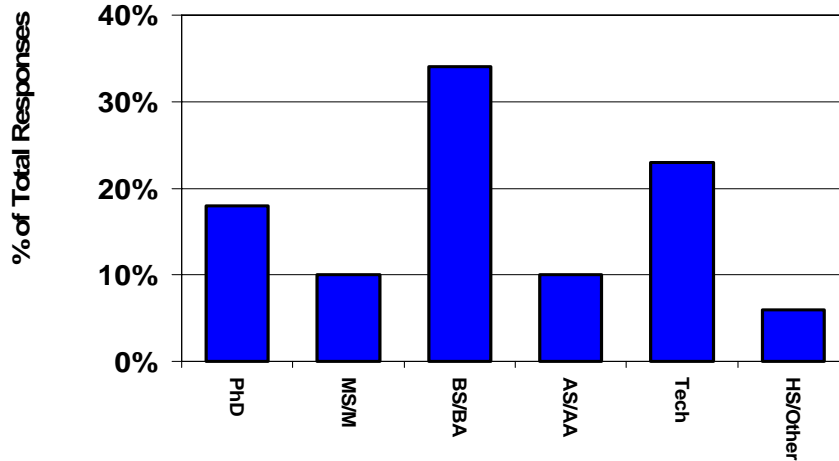


Figure 5: We asked companies to give us the number of employees in each education level. Not all companies could respond for all employees in their companies. The percent is not of the total employees, but the total number of employees that they were able to classify, which was 1220.

## Distribution of Careers

To determine the areas of the industry that employ the greatest number, the companies were asked to provide a breakdown of their employees by job type. Most employees of the surveyed companies were classified as “Research and Development” (31%), which is not surprising due to the large number of companies in the start-up stage. The next largest group was in “Production,” with 27%. Areas such as Quality Control, Quality Assurance and Regulatory Affairs make up a smaller percentage (2%), which may be due to the large number of start-up companies unable to afford a full time staff in those areas. (figure 6)

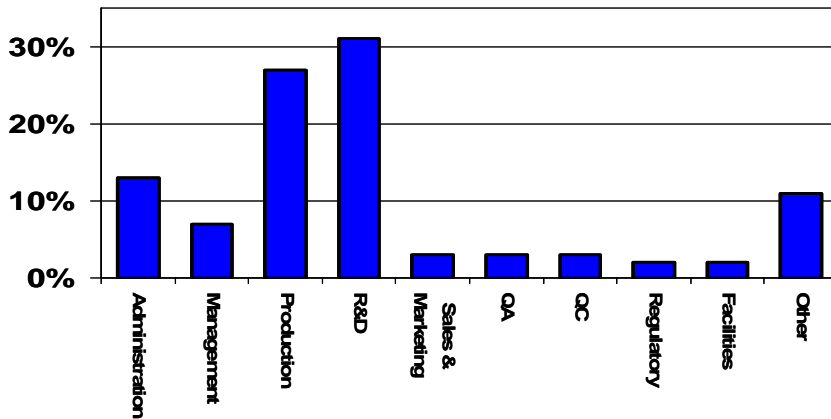
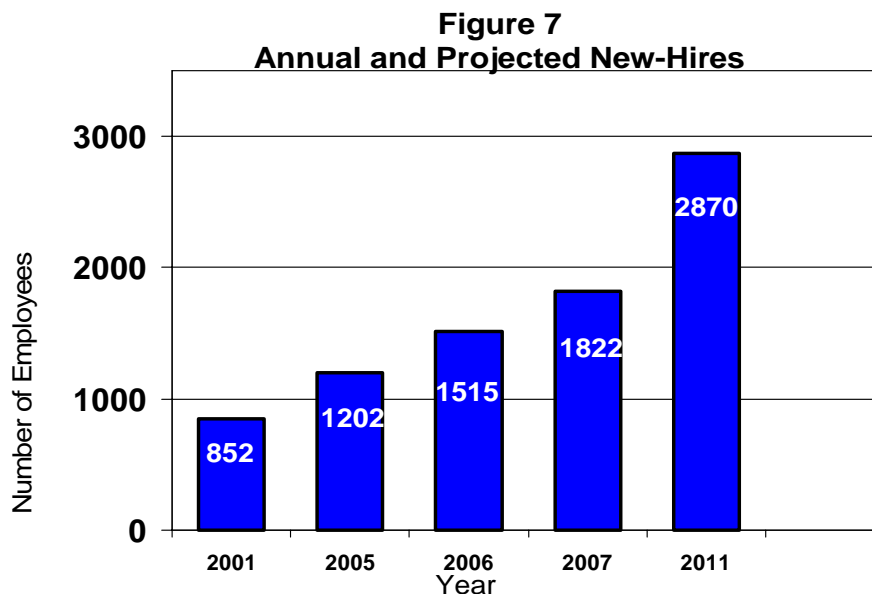


Figure6: We asked companies to give us the number of employees for defined job types. Not all companies could respond and in some companies, employees have over lapping duties. The percent is not of the total employees, but the total number of employees that they were able to classify, which was 1240.

## Company Growth/Job Openings

To approximate the number of positions that will become available in industrial biotechnology, and to trend the growth of the field, survey participants were asked to give the numbers of employees from 2001, 2005, and 2006, then project the number of new-hires for the next one and five years. Growth of employment within the industry is evident since 2001, with a 78% increase in the number of new-hires from 2001 to 2006 (852 employees to 1515 employees respectively). Projected new hires show an increase of 20% in the next year (2007), and an 89% increase from 2006 to 2011 (1515 to 2870 employees respectively). See figure 7



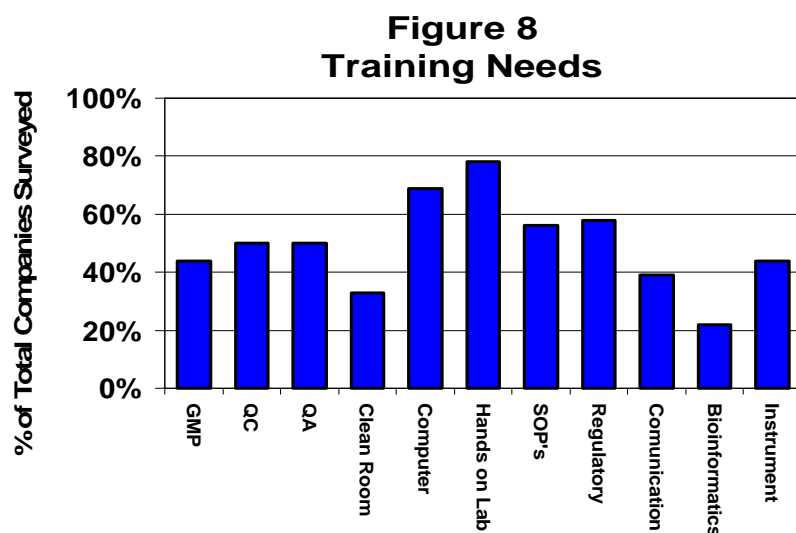
The 2006 value is based on the total number of employees stated by the companies. We asked companies how many employees they had hired in the last year, and last 5 years, then subtracted that number from the total current employees to derive the 2001 and 2005 values. We asked companies to predict how many new employees would be hired in the next year, and next 5 years, then added that number to the total 2006 employee number to derive the 2007 and 2011 values.

Based on our survey, employment in the biotechnology-based industry in Florida has grown at an average annual rate of 15.6% over the past five years, and is anticipated to grow at an average annual rate of 9.4% in the next five years, the United States' growth rate was estimated at 13.5% (2004-2009) and 14.1% (2009-2014) over a five year span by the Milken study. Applying the rate of growth indicated by the survey sample of companies within the state to the current number of employees calculated by the NAICS and 2004 Milken study, industrial biotechnology as a whole can be expected to possibly generate approximately 750 new scientific and technical jobs per year, for an estimated 3,750 jobs to be created in the next five years.



## Employ Florida BANNER Center for Biotechnology Industry Needs Survey: Employee Skills/Training Needs

In correlation with developing a skilled workforce, the training needs of existing employees is a critical indicator or what knowledge and skills are most in demand by the industry. In our survey, we asked participants to identify the areas of training they would most like to have available to their employees. The diagram below (figure 8) illustrates the responses.



We asked companies to mark the type of training their company would need in the future, they were allowed to choose more than one. We totaled the number marked for each category and divided by the total number of companies surveyed.

Industry respondents to our survey noted a need in all of the categories illustrated in figure 8. The most commonly mentioned need was direct, hands-on training specific to techniques used by the industry, which is a skill that is not taught in most biological or science-based Bachelor's of Science programs. Computer literacy and skill was also ranked high, with an increasing demand in equipment automation and data analysis programs. Because the pharmaceutical industry is highly regulated by the FDA, skills that include working in a "Good Manufacturing Practices" (GMP) environment are also in demand, as well as an aptitude for the Regulations, and QA/QC skills and processes. Feedback from our industry-driven Focus Group supported these identified needs, with many of the start-up companies stating that they need employees that can multi-task in several of the areas, as the start-up companies can not afford separate personnel to conduct QA and QC.

## Availability of Education and Training

In response to the growing demand for a trained workforce in biotechnology, universities, community colleges, and most recently high schools have developed programs to address the need.

### Community College A.S. programs in Biotechnology

Currently there are six community colleges offering A.S. degrees in biotechnology, which include: Santa Fe Community College, Gainesville; Florida Community College Jacksonville; Palm Beach Community College, Palm Beach; Edison Community College, Ft. Myers; Miami-Dade College, Miami-Dade; and Indian River Community College, Ft. Pierce. For Statewide course numbers, see Appendix F.

Students earning an A.S. degree must complete six core courses which include:

BSC 1404C	Introduction to Biotechnology Methods
BSC 1421	Introduction to Biotechnology
BSC 2423C	Protein Cell/Biotech Culture
BSC 2426C	Biotechnology Methods I
BSC 2427C	Biotechnology Methods II
BSC 2943	Industry Internship

The traditional A.S. degree programs in biotechnology prepare individuals for entry-level employment as biotechnology research technicians, biotechnology manufacturing technicians, and cell culture technicians by providing them with the following skills: making chemical reagents, performing biochemical analyses, using recombinant DNA techniques, culturing bacteria or animal or plant cells, purifying and/or characterizing DNA and proteins, and collecting and assessing data. Students also develop essential work skills such as professional behavior and appearance, dependability, ethics, following directions, and team work.

Outside the traditional program, Florida Community College of Jacksonville and Miami-Dade Community College also offer a certificate program in Bioinformatics. As part of their A.S. degree, Palm Beach Community College offers coursework in working in Controlled environments, Patent Law, Quality Assurance and Quality Control. Santa Fe Community College is developing a similar program, offering students specialty options in Regulatory Affairs/QA/QC and industrial biotechnology manufacturing.

Although they are not offering complete programs in biotechnology, Brevard Community College offers an A.S. degree in Chemical Technology with a Biotechnology option (offering BSC 1404C and BSC 1421), and Tallahassee Community College has an articulation agreement with SFCC allowing students to earn an A.S. in Biotechnology. St. Petersburg College, as part of their Engineering program offers coursework in Quality Assurance and Process Metrology.

## Universities offering B.S. degrees in Biotechnology:

There are currently four 4-year institutions in Florida offering degrees in Biotechnology, either as a track within a Biology degree (Florida Atlantic University in Boca Raton, and Barry University in Miami Shores), or as specific degrees (Florida Gulf Coast University in Fort Myers, and Florida Institute of Technology in Melbourne). The degree programs are varied, and described below:

### ***Florida Atlantic University, Boca Raton***

**Program Description:** Intended for students earning a degree in Biology who have an interest in the scientific study of the use of living organisms or their products to modify human health and the human environment, the scientific study of microorganisms and the scientific study of the structure, function, and makeup of biologically important molecules.

Core Courses Offered:

BSC 4403L	Biotechnology I Lab
BSC 4405L	Biotechnology II Lab

Students must also complete courses in Biology, Chemistry, Biochemistry, Organic Chemistry, Molecular Biology, Physics, Genetics and Microbiology. Students also choose from degree electives in Immunology, Virology and other advanced sciences, along with general educational courses required for a B.S. degree.

### ***Florida Gulf Coast University, Ft. Myers***

**Program Description:** This program prepares students for pursuing graduate studies, or entering the work force in industrial, academic or governmental laboratories upon graduation. In addition this program serves as a pre-professional track and a foundation for acceptance into medical, dental, veterinary or pharmacy schools.

Core Courses Offered:

BSC 4422C	Methods in Biotechnology
BSC 4942	Senior Research in Biotechnology
BSC 4943	Senior Project Presentation in Biotechnology
BSC 4941	Internship in Biotechnology
BSC 4905	Directed Independent Study/Research in Biotechnology

The program also requires students to complete courses in Biology, Chemistry, Biochemistry, Organic Chemistry, Cell Biology, Physics, Molecular Genetics and Microbiology. Students also choose from degree electives in Plant, Animal, Marine and Environmental Biology, along with general educational courses required for a B.S. degree.

***Barry University, Miami Shores***

**Program Description:** Intended for students earning a degree in Biology to prepare them for careers in industrial and commercial settings as well as medical centers. The required internship covers an entire semester or a summer session to provide work experience in a laboratory setting.

Core Courses Offered:

BIO 235	Introduction to Biotechnology Workshop
BIO 256	Tissue Culture Techniques
BIO 471	Biotechnology Internship

The program also requires students to complete courses in Biology, Chemistry, Biochemistry, Organic Chemistry, Cell Biology, Physics, Genetics, Microbiology, Virology, and Immunology.

**Graduate Level Programs in Biotechnology**

There are currently two academic institutions in Florida offering graduate level programs in Biotechnology. They include:

***Florida Institute of Technology, Melbourne***

**Program Description from the College, M.S. Degree:** The master's program in biotechnology is a non-thesis program that builds on Florida Tech's unique location on the Atlantic coast, and its established strengths in marine biology, marine ecology, natural products chemistry, molecular biology and biochemistry to provide a path for students who aspire to learn biotechnology and earn jobs in industry. The program is focused on those areas of biotechnology related to microbiology, natural products chemistry and molecular biology of marine organisms.

Core Courses Offered:

BIO 5522	Bioinformatics, Genomics, and Proteomics
BIO 5535	Current Topics in Biotechnology
BIO 5537	Applied Biotechnology
BIO 5515	Pharmacology and Drug Design
BIO 5539	Microbial Biotechnology

The master's degree in biotechnology is a non-thesis option and requires the satisfactory completion of 33 credit hours, including a maximum of 27 hours formal course work (six credit hours of research may substitute for six credit hours of formal course work), seminars (BIO 5990), and up to 12 credit hours of industrial internship (BIO5997) and/or

summer laboratory experience (BIO 5537) at Florida Tech. A project report on the research experience is written, presented and defended before a committee. The committee, the composition of which is similar to that for the master's degree, may ask questions relating to previous course work.

***University of South Florida, Tampa***  
**Graduate Certificate in Biotechnology**

**Program Description:** This certificate provides both biological and chemical scientists and engineers with the necessary coursework for a broad understanding of the principles of biotechnology and their application to different biological, biomedical, chemical and engineering problems.

Program Requirements:

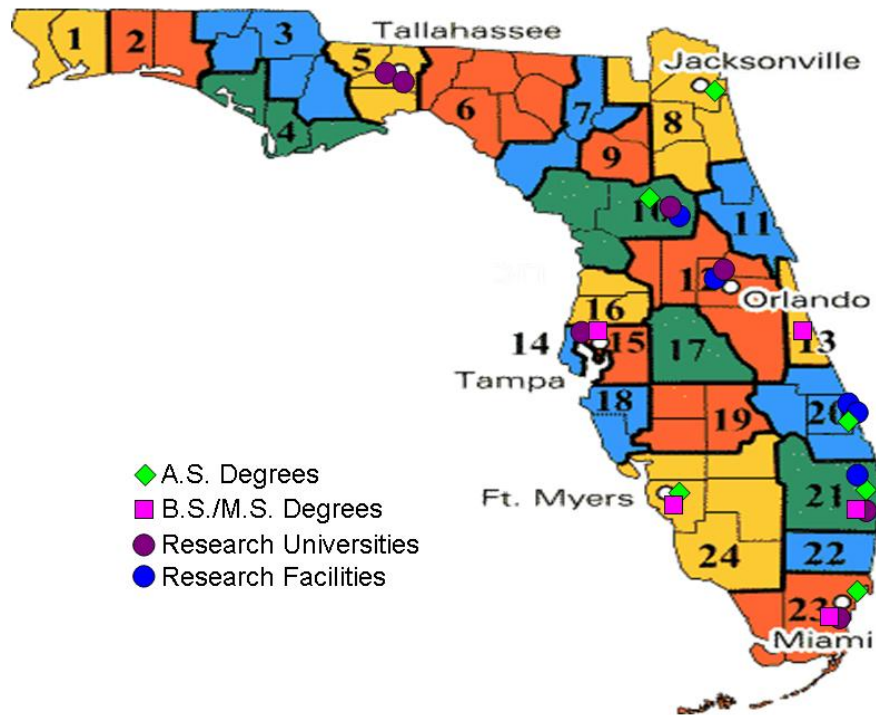
GMS 6200	Biochemistry, Molecular & Cellular Biology
GMS 7930	Introduction of Biotechnology
GMS 7939	Graduate Seminar
BCH 6746	Proteomics and Structural Biology OR
BCH 6411	Molecular Biology OR
BCH 6135	Methods in Molecular Biology

**High School Biotechnology Curricula:**

In October of 2006 the University of Florida 's Center of Excellence for Regenerative Health Biotechnology in partnership with the Alachua, Marion, and Palm Beach School Boards submitted a 3-year curriculum for industrial biotechnology. Biotechnology I and Biotechnology II (years one and two) were approved by the State in December, 2006 and will be on the Florida High School Course Code Directory to be available to students in August, 2007. Students who complete the three-year sequence will be eligible to articulate directly to the second year of the SFCC Biotechnology program.

The diagram below (figure 9) illustrates the regions of Florida with post-secondary program in Biotechnology. Note the correlation with industry clusters (see figure 2). Research Universities and Facilities are included on the map to indicate locations of research in biotechnology.

Figure 9  
Distribution of Biotechnology Training Programs



Research Universities

- University of Florida, Gainesville
- University of South Florida, Tampa
- University of Central Florida, Orlando
- Florida A&M University, Tallahassee
- Florida State University, Tallahassee
- Florida Atlantic University, Boca Raton
- University of Miami, Coral Gables

Research Facilities

- Scripps Florida, Jupiter
- Torrey Pines Institute for Molecular Studies, Port St. Lucie
- Burnham Institute for Medical Research, Orlando
- Sea Grant Program, Gainesville
- Harbor Branch Oceanographic Institution, Ft. Pierce

**Conclusion:**

There are strategically located programs in the state that provide training in laboratory biotechnology, however they do not currently provide real-life training of skills needed in the corporate setting. Feedback from industry representatives in our Focus Group meeting (December 11, 2006) also indicates that it is difficult to find qualified applicants for biomanufacturing positions, because they generally lack knowledge about the industry as well as the basic skills. Given the growth and projected growth within the state of the industry, there is a strong need to establish comprehensive, targeted training programs in biotechnology.

## Appendix A: Biotechnology Industry List and Classification

Company	City	Workforce Region	Classified
Abc Research	Gainesville	9	Diagnostic
Abrika, Llp	Sunrise	22	Pharm
Alfa Laboratories Inc	Miami	23	Pharm
Altor Bioscience Corp.	Miramar	22	Bioproduct
Ambi Pharmaceuticals, Inc	Brooksville	16	Pharm
Animal Genetics	Tallahassee	5	Diagnostic
Apical Pharmaceutical Corp.	Miami	23	Pharm
Applied Genetic Technologies Corp	Alachua	9	BioPharm
Applied Genetics Laboratories, Inc.	Melbourne	13	Diagnostic
Argonide Nanomaterial Technologies	Sanford	12	Product
Aveva Drug Delivery Systems	Miramar	22	BioPharm
Avian Biotech International	Tallahassee	5	Diagnostic
Avirid Biotechnology	Gainesville	9	BioPharm
Awareness Technologies	Palm City	20	Device
AxoGen, Inc	Gainesville	9	BioPharm
Axontologic	Orlando	12	Bioinformatics
Balassa Laboratories Inc	Dayton Beach	11	Pharm
Banyan Biomarkers	Alachua	9	Diagnostic
Baxter Healthcare Corporation	Pinellas Park	14	Pharm
Bio Nucleonics Inc.	Miami	23	Pharm
Bioavailability Systems, LLC	Cocoa Beach	13	BioPharm
Biodyne Inc.	Sarasota	18	Bioproduct
Bioheart, Inc.	Weston	22	BioPharm
BioMed Immunotech	Alachua	9	Diagnostic
BioMedTech Laboratories, Inc	Tampa	15	Bioproduct
Bioprodex	Gainesville	9	Ag/Marine Biotech
Bioresource Technology, Inc.	Fort Lauderdale	22	Bioproduct
Bio-Tissue	Miami	23	BioPharm
BioTools	West Palm	21	Diagnostic
Cardiovascular Sciences	Orlando	12	Device
Celunol, Corp.	Alachua	9	BioProduct
Chiral Corp	Miami	23	Pharm
CHS Resources	Boca Raton	21	Pharm/R&D
Concordia Pharmaceuticals, Inc.	Sunrise	22	Pharm/R&D
Cryo-Cell	Clearwater	14	BioPharm
Custom Biologicals	Boca Raton	21	Bioproduct
Custom Synthesis Inc.	Delray Beach	21	Bioproduct
CyGene, Inc.	Coral Springs	22	Diagnostic



Cytorex Biosciences Inc	Weston	22	Pharm/R&D
DNAPrint Genomics Inc	Sarasota	18	Diagnostic
DOR BioPharma	Miami	23	BioPharm
Dyadic International	Jupiter	21	Bioproduct
EcoArray LLC	Alachua	9	Diagnostic
ELISA Technologies, Inc.	Gainesville	9	Diagnostic
EnCor Biotechnology Inc	Alachua	9	Bioproduct
Environmental Biotech	Sarasota	18	Bioproduct
Exactech, Inc.	Gainesville	9	Device
Firebird Biomolecular Sciences	Gainesville	9	Bioinformatics
Florida Biologix	Gainesville	9	BioPharm
Geltex Pharmaceuticals	Tampa	15	Diagnostic
GeneEx Inc	Plantation	22	Diagnostic
GenoMechanix, LLC	Gainesville	9	Bioproduct
GeoPharma	Largo	14	BioPharm
Global Laboratories, Inc.	Gainesville	9	Diagnostic
GMP Companies, Inc	Ft. Lauderdale	22	Device
Goodwin Biotechnology, Inc	Plantation	22	BioPharm
Haemacure	Sarasota	18	BioPharm
Halogenetics	Aventura	23	Pharm/R&D
Hema Diagnostic Systems	North Bay Village	23	Diagnostic
Hemacare Bioscience	Ft. Lauderdale	22	Bioproduct
Hydroshpere Research	Alachua	9	Diagnostic
Hypercube	Gainesville	9	Bioinformatics
Imigene	Tampa	15	Diagnostic
Immugen Pharmaceuticals Inc	Miami	23	Pharm/R&D
Implant Innovations (3i)	Palm Beach	9	Device
Industrial Biotechnology Corporation	Sarasota	18	Bioproduct
Integrated Plant Genetics Inc	Alachua	9	Ag/Marine Biotech
Intezyne Technologies	Tampa	15	Pharm/R&D
Isoprenoids	Tampa	15	Bioproduct
Ixion Biotechnology, Inc	Alachua	9	BioPharm
Life Sciences, Inc.	St. Petersburg	14	Bioproduct
Magellan Bioscience Group	Tampa	15	Bioproduct
Medtronic Xomed	Jacksonville	8	Device
Morphogenesis Inc	Oldsmar	14	BioPharm
Nabi Biopharmaceutical	Boca Raton	21	BioPharm
Nanobac Life Sciences	Tampa	15	Diagnostic
NanoMedex	Alachua	9	Pharm/R&D
Nanopharma Technologies Inc.	Tampa	15	BioPharm
Nanosystems Research, Inc	Alachua	9	Device
Nanotherapeutics	Alachua	9	Pharm/R&D
National Healing Corporation	Boca Raton	21	BioPharm
Natural Resource Protection	Ft. Lauderdale	22	Bioproduct

NeoCytex Biopharma	Orlando	12	BioPharm
Neogen Corporation	Tampa	15	Ag/Marine Biotech
Neogenomics	Ft. Myers	24	Diagnostic
Nephron Pharmaceuticals Corporation	Orlando	12	Pharm
Nippon Soda Co, LTD	Alachua	9	Ag/Marine Biotech
Novabone	Jacksonville	8	BioPharm
Novamin	Alachua	9	Pharm
Noven Pharmaceuticals, Inc	Miami	23	Pharm
Nutra Pharma/ReceptoPharm	Boca Raton	21	BioPharm
Ocean Research & Conservation Assoc.	Fort Pierce	20	Ag/Marine Biotech
Ocean Ridge Biosciences	Jupiter	21	Diagnostic
Oglesby Plant Laboratories Inc	Altha	3	Ag/Marine Biotech
One Biotechnology Co	Sarasota	18	Bioproduct
Oragenics Inc	Alachua	9	BioPharm
OrbusNeich	Ft. Lauderdale	22	Bioproduct
Osprey Biotechnics	Sarasota	18	Bioproduct
Oxthera	Alachua	9	BioPharm
Pasteuria Biosciences LLC	Alachua	9	Ag/Marine Biotech
Pegasus Biologics Inc.	Alachua	9	Device
PPR&D Biomarkers Inc	Tampa	15	Diagnostic
Quick-Med Technologies, Inc.	Gainesville	9	Pharm/R&D
ReceptoPharm	Plantation	22	BioPharm
Regeneration Technologies Inc	Alachua	9	Device
RegenMed	Gainesville	9	BioPharm
RFE Pharma	Alachua	9	Pharm/R&D
Saneron CCEL Therapeutics, Inc	Temple Terrace	15	BioPharm
Smith & Nephew Inc	Largo	14	Pharm
Somerset Pharmaceuticals	Tampa	15	Pharm
Source Molecular Corporation	Miami	23	Diagnostic
St. Charles Pharmaceuticals	Alachua	9	Pharm/R&D
Synergxcorp	Oldsmar	14	BioPharm
Syngenta Crop Protection		20	Ag/Marine Biotech
Taxolog	Tallahassee	5	Pharm/R&D
Tenby Pharma, Inc.	Tampa	15	Pharm/R&D
Tequesta Marine Biosciences	Boca Raton	21	BioPharm
Teva Pharm/Ivax	Miami	23	Pharm
Tigris Pharmaceuticals, Inc	Bonita Springs	24	BioPharm
Toxin Technology, Inc.	Sarasota	18	Bioproduct
Transdermal Technologies	Lake Park	21	Pharm/R&D

TransGenex Therapeutics Inc	Tampa	15	Diagnostic
Tutogen Medical, Inc.	Alachua	9	Device
Universal Air Technologies	Alachua	9	Device
US Spine	Boca Raton	21	Device
USBiomaterials	Alachua	9	BioPharm
VaxDesign Corporation	Orlando	12	Diagnostic
Vicor Technologies Inc	Boca Raton	21	BioPharm
Viragen, Inc	Plantation	22	BioPharm
Watson Pharma	Davie	22	Pharm

## **Appendix B: 2005 North American Industry Classification System (NAICS)**

NAICS 3254 Pharmaceutical and medicine manufacturing

NAICS 32541 Pharmaceutical and medicine manufacturing

NAICS 325411 Medicinal and botanical manufacturing

NAICS 325412 Pharmaceutical preparation manufacturing

NAICS 325413 In-vitro diagnostic substance manufacturing

NAICS 325414 Other biological product manufacturing

NAICS 3391 Medical equipment and supplies manufacturing

NAICS 33911 Medical equipment and supplies manufacturing

NAICS 339111 Laboratory apparatus and furniture mfg.

NAICS 339112 Surgical and medical instrument manufacturing

NAICS 339113 Surgical appliance and supplies manufacturing

NAICS 339114 Dental equipment and supplies manufacturing

NAICS 339115 Ophthalmic goods manufacturing

NAICS 339116 Dental laboratories

NAICS 5417 Scientific Research and Development Services

NAICS 54171 Research and Development in the Physical, Engineering, and Life  
Sciences

NAICS 541710 Research and Development in the Physical, Engineering,  
and Life Sciences

## Appendix C: Employ Florida BANNER Center for Biotechnology Industry Survey



### Training Program Industry Survey

Company Name: \_\_\_\_\_

Contact Person: \_\_\_\_\_ Title: \_\_\_\_\_

Contact Info: email: \_\_\_\_\_ phone: \_\_\_\_\_

1. How many employees does your company currently employ? Total \_\_\_\_\_

How many by department? Administration \_\_\_\_\_ Management \_\_\_\_\_

Production \_\_\_\_\_ R&D \_\_\_\_\_ Sales/Marketing \_\_\_\_\_ QA \_\_\_\_\_

QC \_\_\_\_\_ Regulatory \_\_\_\_\_ Facilities \_\_\_\_\_ Other \_\_\_\_\_

2. How many current employees do you employ at the following educational levels?

PhD \_\_\_\_\_ BS/BA \_\_\_\_\_ AS/AA \_\_\_\_\_ Technical \_\_\_\_\_

Other \_\_\_\_\_

3. How many employees did your company hire in the last year? \_\_\_\_\_

last five years? \_\_\_\_\_

4. What is the current stage of your company? Start-up: \_\_\_\_\_ Growth: \_\_\_\_\_

Commercial Operational : \_\_\_\_\_ Other: \_\_\_\_\_

5. What is your estimated number of new hires for the next year? \_\_\_\_\_

In what areas? \_\_\_\_\_

At what level? \_\_\_\_\_

6. What is your estimated number of new hires for the next five years? \_\_\_\_\_

In what areas? \_\_\_\_\_

At what level? \_\_\_\_\_

7. In what areas do your employees need additional training? \_\_\_\_\_

\_\_\_\_\_

8. What skill sets do your current or future employees need to be trained in?

GMP's \_\_\_\_\_ QC \_\_\_\_\_ QA \_\_\_\_\_ Clean room \_\_\_\_\_ Computer \_\_\_\_\_

Hands-on Lab \_\_\_\_\_ SOP's \_\_\_\_\_ Regulatory \_\_\_\_\_

Communication \_\_\_\_\_ Bioinformatics \_\_\_\_\_ Instrument \_\_\_\_\_

Other \_\_\_\_\_

9. What absence duration can your company tolerate while your employees are being trained? \_\_\_\_\_

10. What is the preferred method of training for current or future employees?

Via Web \_\_\_\_\_ Off site (at Training Center) \_\_\_\_\_ On site \_\_\_\_\_

Hybrid \_\_\_\_\_ Other \_\_\_\_\_

## Appendix D: Survey Results

### Company Profile

ID#	Total # Employees	Number of Employees by Job (some job overlap)									
		Admin	Man	Prod	R&D	Sales	QA	QC	Reg	Fac	Other
1	0										
2	8	2		4	2						
3	5	1		4							
4	130	4	6	60	9	6	6	15		4	
5	200	39			166						
6	12	3	2		9						
7	50		6	35		2	2	2			7
8	82	5			74		1			2	
9	0										
10	9	6	6	9	9	6					
11	7	7	7	7							
12	2		2								
13	12	4	2	4	1	3	1	1	1		
14	7		1		6						
15	3										
16	61	18	7		2	1	2	2		1	
17	21	4	5		12						
18	13	1	2	2	4	1	1				
19	9	1	1		3				1		
20	2	1				1					
21	7	1	1		5						
22	3	1			2						
23	1										
24	6	1	1		4						
25	12	2	1	2	4	1	1	1			
26	19	4	5	3	4	1	1				
27	10	4	3	7	3						
28	26	3.5	3		18	1	2	9	1		
29	4		1		3						
30	4	1			3						
31	81	7	7	34	2	7	8	4	3	1	
32	12	1	2	3	4	1	1				
33	225	30	10				2	2	18	3	130
34	32	5	6	6	2	2	4	3	1	3	
35	35	1	1		28					6	
36	405			150							

Total #	1515										
Answered	1240	157.5	88	330	379	33	32	39	25	20	137
% of # Answered		13%	7%	27%	31%	3%	3%	3%	2%	2%	11%

## Education Levels

ID#	Education Level of Current Employees					
	PhD	MS/M	BS/BA	AS/AA	Tech	HS/Other
1						
2	1	1	2			2
3		2	2			
4			12	10	30	
5	90	20	60	10		
6	4	8				
7	3	7	32			8
8	15		36	8	3	28
9						
10	1		8			
11	5		2			
12	1	1				
13	1	4			3	
14	6		1			
15	1	1	1			
16	7		10	10	4	
17	5		12	2		
18	2	4	7			
19	5	2	2			
20	1					
21	1		5			
22		2		1		
23	1					
24	2		4			
25	4	2	4			
26	1		6			
27	3		4	1	2	
28	5		15	1		
29	1	1	1	1		
30	2		2			
31			20	8	25	28
32	1		9			2
33	10	20	80	15		
34	5	23			4	
35	25		3	2	5	
36	15	20	75	50	200	

Total	224	118	415	119	276	68
#						
Answered	1220					
% #						
Answered	18%	10%	34%	10%	23%	6%



## Hiring Projections, 1 Year

ID#	Estimated New Hires in the Next Year	
	Positions	Levels
1	R&D, Admin	all levels
2	R&D, field	BS
3	N/A	N/A
4	eng, software	BS/BA
5	research staff	all levels
6	R&D, Admin	PhD, MS, BS
7	production	PhD, MS
8	R&D, lab scientists	MS, BS
9	admin, science	BS/BA , MD, PhD, Masters
10	genetics	BA
11	tech, business	PhD, BS/BA
12	admin	executive assistant
13	N/A	N/A
14	Biotechnology	PhD/MS/BS
15	science	PhD/BS
16	Micro/CHM	BS
17	Research Assoc., VP Clinical, Chief Med Officer	BS/PhD-Medical Degree/Exec
18	Adm., R&D, Clinical Trial, Facilities, Sale/MKT	Entry, MGMT
19	Adm., QC	College lab tech., BS/BA
20	R&D,	2-4 yr degree
21	R&D	PhD, BS/MS
22	R&D	N/A
23	N/A	N/A
24	N/A	N/A
25	Product development, Clinical	PhD, MS, BS
26	Mkt.	Exp.
27	Scientist	PhD
28	Project MGR.	Exp.
29	MGMT., R&D, Sales	MBA, PhD, BS, BS/BA, AS/AA
30	N/A	N/A
31	Production, QC, QA Facilities, IT, Sales/Mdt., R&D, HR	PhD, BS, AS, Tech, other
32	Marketing, R&D, production	BS
33	Tech, Admin	PhD, BS
34	production	technical
35	plant pathology R&D, entomology R&D, greenhouse support	PhD, BS
36	Variety	varied

## Hiring Projections, 5 Years

ID#	Estimated New Hires for the Next Five Years	
	Positions	Levels
1	R&D, Admin	all levels
2	R&D, Admin	BS, AS
3	N/A	N/A
4	R&D, manufacturing	BS/BA,HS
5	research staff	all levels
6	R&D, admin, marketing	PhD, MS, BS
7	production	PhD, MS
8	biotechnology and laboratory techs	all levels
9	same, but 75% science	BS/BA , MD, PhD, Masters
10	genetics	BS
11	research, sales	PhD, BS/BA
12	R&D, production	MS/BS
13	R&D, mfg	entry, junior chemist
14	R&D	all levels
15	N/A	N/A
16	Micro/CHM	BS
17	Reg.,QA.QC	N/A
18	Sales/MKT	All levels
19	R&D, Production	N/A
20	Marketing, Production, R&D	2-4 yr degree
21	R&D	PhD., BS/MS
22	R&D, Production, Adm	N/A
23	N/A	N/A
24	N/A	N/A
25	Development, Clinical, Regulatory	All
26	N/A	N/A
27	N/A	N/A
28	N/A	N/A
29	MGMT., R&D, Sales	MBA, PhD, BS, BS/BA, AS/AA
30	N/A	N/A
31	Production, QC, QA Facilities, IT, Sales/Mdt., R&D, HR	PhD, BS, AS, Tech, other
32	R&D, production	HS, BS, MS
33	Tech	PhD, BS, AS
34	reg, tech, downstream, cell culture	PhD, tech
35	crop protection R&D, lab/greenhouse/field support	PhD, BS
36	Varied	Variety

## Hiring Trends

ID#	Number Hired Past		Projected New Hires		Stage of Company
	1 Yr	5 Yr	1 Yr	5 Yr	
1	0	0	5	100	Growth
2	1	8	4	7	Start-up/Growth/Commercial
3	0	1	0	0	Commercial
4	30		10	40	Growth/Commercial
5	50	200	50	300	Start-up
6	12		6	20	Start-up
7	10	20	5	15	Commercial
8	18	50	12	35	Growth
9	0	0	31	165	non-profit biomedical research
10	0	0	2	3	Commercial
11	3	7	5	25	Growth
12	0	5	1	10	Start-up Growth
13	4	12	0	4	Commercial
14	0	7	2	depends	Start-up
15	1		3	depends	Growth
16	2	70	13	13	Growth
17	5		2	15	Start-up
18	7	13	5	40	Start-up
19	2	9	2	3	Start-up
20	3		2	5	Start-up
21	5		3	5	Start-up
22		2	2	10	Start-up
23					
24	3	30			Start-up
25	1	10	10	35	Growth
26	5	8	3	depends	Growth
27	3	25	1	depends	Start-up
28	7		1	depends	Start-up
29	1	1	9	15	Start-up
30	3	4		depends	Growth
31	36	50	50	70	Commercial
32	2	8	3	10	Growth
33	20	80	20	50	Clinical Testing
34	26	32	2	10	Commercial
35	3	11	3	0	Commercial
36	50	na	40	350	Commercial

Total	313	663	307	1355	start-up = 15
% of Current	21%	44%	20%	89%	growth = 12 Commercial = 11 other = 2

# Training Needs

ID#	Areas of Training Needs											
	GMP	QC	QA	C/R	Com	lab	SOP	Reg	Comun	Bioinfo	Instr	Other
1					X	X						
2	X	X	X		X	X	X		X		X	gov't relations
3		X	X		X	X	X	X	X		X	
4	X	X	X	X	X			X				
5				X	X	X		X			X	safety, environ issues
6					X							
7	X	X	X	X	X	X	X	X	X			
8			X		X	X	X			X	X	
9												biotechnology
10	X				X	X	X	X	X	X	X	
11	X	X	X			X		X	X		X	
12	X	X		X	X	X	X	X	X	X	X	
13	X	X	X	X	X			X				
14	X	X	X	X	X	X	X	X	X	X	X	
15				X		X						
16						X						
17					X			X				
18	X					X	X	X			X	Sales
19	X	X	X		X	X	X	X	X		X	
20		X	X	X	X	X	X	X		X		
21					X	X						
22		X	X		X	X	X			X		
23												
24					X	X		X				
25	X	X	X		X	X	X	X			X	
26		X	X		X				X			
27					X		X	X				
28					X	X					X	
29						X			X			Bus., Fermenter, Bioreactors
30	X	X	X	X		X	X	X	X	X	X	
31	X	X	X	X	X	X	X	X	X			
32	X	X	X			X	X	X	X			
33		X	X		X	X	X	X		X	X	ethics
34	X			X		X	X				X	
35						X	X					
36	X	X	X	X	X	X	X	X	X		X	

Number	16	18	18	12	25	28	20	21	14	8	16
% of # companies	44%	50%	50%	33%	69%	78%	56%	58%	39%	22%	44%

## Delivery Window

ID#	Duration	Duration of Training Sessions			
		< 1day	2-4 days	1 week	> 1 week
1	1-3 days		X		
2	3-5 days		X		
3	1 week			X	
4	1-2 weeks				X
5	2 hours, but variable	X			
6	1/2 days or 3-day session w/ wireless access		X		
7	2 days		X		
8	2-5 days		X		
9					
10	1 month				X
11	1 per week			X	
12	1-2 weeks				X
13	1-2 weeks				X
14	2hrs/week	X			
15	none-prefer on site training	X			
16					
17	1-2 days per week		X		
18	1 hr 2 days per week		X		
19	2 days a month	X			
20	1 day per week	X			
21	48 hrs per		X		
22	40 hrs		X		
23					
24	1 day per week	X			
25	1-2 days per week		X		
26	1 to days per week		X		
27	1-2 days per week		X		
28	1-2 days per week		X		
29	2 to 5 hrs per week	X			
30	2 days per week		X		
31	2 days a month	X			
32	1 week			X	
33	1 week , 1 day			X	
34	1/2 to 5 days week		X		
35	depends				X
36	4 hrs per week	X			

number	9	15	4	5
percent	27%	45%	12%	15%

## Delivery Method

ID#	Delivery Method				Additional Training
	web	center	on-site	hybrid	
1	X	X	X	X	safety
2		X			safety, lab analyses, DNA, chromatography, aseptic technique
3	X		X		regulations, OSHA, FDA
4		X	X		production processes, efficiency, 3-D modeling
5	X		X		safety, mgmnt, supervisory skills, computer training
6	X	X			ocean/electrical engineering
7					computer skills, otherwise do much of their own training
8			X		mgmnt skills
9	X		X		
10		X			none
11	X	X	X	X	GLP/BMP
12	X		X	X	Regulatory
13			X		
14	X				
15			X		Biotechnology
16	X			X	Manager
17			X		Project Mgmt, Basic Course in Regulatory-How to deal with agency
18				X	Sales Training, Regulatory
19	X	X	X	X	GLP, GMP, QC
20	X		X		
21	X				
22	X	X			Statistical & GLP
23					
24		X	X		Wet lab skills (if business picks up)
25		X	X		
26	X		X		Project MGMT.
27	X				Regulatory
28	X				Equipment, Technical
29	X	X			GLP
30			X		R&D
31		X			RA, Quality, Safety, OSHA, Biohazard, Biomedical MFG, MGMT/Super., Tech
32	X		X		Safety, QC, Communication, SOP's
33	X	X		X	chemistry, molecular bio, computer, science, safety
34			X		
35	X	X	X		we use multi methods depending on the nature of the need
36			X		

19      13      18      7  
58%    39%    55%    21%

## Appendix E: Statewide Course numbers for Biotechnology

Statewide Course	Title	State Description
404	HONORS QUANT BIOL METHODS (Intro to Biotech Methods)	A LABORATORY COURSE WHICH PRESENTS MODERN METHODS AND INSTRUMENTATION USED IN QUANTITATIVE BIOLOGICAL EXPERIMENTATION.
419	PLANT AND ANIMAL CELL CULTURE	THE THEORIES AND TECHNIQUES USED IN ISOLATING AND CULTIVATING ANIMAL AND PLANT CELLS IN VITRO. APPLICATIONS OF CELL CULTURE TO SOLVING PROBLEMS IN AGING, CANCER, TOXICOLOGY, AND GENETIC ENGINEERING.
420	BIOTECHNOLOGY	PRINCIPLES, APPLICATIONS, LAWS, ETHICS, IMPACT ON SOCIETY OF BIOTECH- NOLOGY IN AGRICULTURE, MEDICINE, FORESTRY, ENVIRONMENT, COMPUTERS/ INDUSTRIAL/CHEMICAL ENGINEERING, AND BUSINESS MANAGEMENT.
421	BIOTECHNOLOGY IN INDUSTRY	INTRODUCTION TO BIOTECHNOLOGY INDUSTRY, WITH EMPHASIS ON CURRENT APPLICATIONS IN MIEDICINE, AGRICULTURE, FORENSICS, ENVIRONMENT. STUDENT ALSO INTRODUCED TO BIO- POCESSING AND QUALITY MANAGEMENT, ETHICAL, LEGAL, SOCIAL ISSUES RELEVANT TO BIO- TECHNOLOGY.
423	PROTEIN BIOTECHNOLOGY AND CELL CULTURE	INTRODUCTION TO PROTEIN BIOTECHNOLOGY, METHODS OF PORTEIN PURIFICATION AND ANALY SES. INCLUDES INSTRUCTION IN BASIC TECHNIQUES OF PLANT AND ANIMAL CELL STRUC- TURE.
426	BIOTECHNOLOGY METHODS I	MODERN CONCEPTS OF MOLECULAR BIOLOGY, WITH LABORATORY FOCUS ON BASIC METHODS FOR PREPARING, ANALYZING NUCLEIC ACIDS.
427	BIOTECHNOLOGY METHODS II	CONTINUED STUDY OF MOLECULAR BIOLOGY, WITH LABORATORY FOCUS ON ADVANCED METHODS FOR MANIPULATING AND ANALYZING NUCLEIC ACIDS.
435	INTRODUCTION TO BIOINFORMATICS	THIS COURSE PRESENTS STUDENTS WITH THE FUNDAMENTAL KNOWLEDGE AND SKILLS OF BIOINFORMATICS. SPECIFIC TOPICS TO BE COVERED INCLUDE: DATA FILE FORMATS, ACCESSING PUBLIC DATABASES FOR RETRIEVAL AND SUBMISSION, ANALYSIS USING COMMON TOOLS, AND SCRIPTING.
941-945	INTERNSHIPS/ PRACTICUMS/ CLINICAL PRACTICE	PRACTICAL APPLICATION IN A CLINICAL SETTING OF KNOWLEDGE ACQUIRED IN THE CLASSROOM. HOURS MAY VARY. LEVELS MAY VARY WITHIN AN INSTITUTION.

## Appendix F: Bibliography

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Freedberg, Sydney P.. *Florida's bidding high for biotech*, October, 2006, St. Petersburg Times.

Milken Institute. *Biopharmaceutical Industry Contributions to State and U.S. Economies*, October 2004.

Vogel, Mike. *Biotech – Sticker Shock?*, Florida Trend, January 2007.

### Web Sites

Enterprise Florida

<http://www.eflorida.com/>

Central Florida Research Park

<http://www.cfrp.org/>

UCF Technology Incubator

<http://www.incubator.ucf.edu/>

UF Sid Martin Biotechnology Incubator

<http://www.biotech.ufl.org/>

Progress Corporate Park

<http://www.progresscorporatemark.com/>

Tampa Bay Technology Incubator

<http://www.incubator.usf.edu/>

USF Research Park

<http://isis.fastmail.usf.edu/researchpark/>

Florida Atlantic Research and Development Park

<http://www.research-park.org/index.html>

Innovation Park

<http://www.innovation-park.com/>

St. Lucie County Education and Research Park

<http://www.tcerda.org/index.shtml>