Critical Skill Shortages Project: An Assessment of Root Causes for Skill Shortages in Biosciences and Biotechnology in Greater Austin

A Report for *Work*Source – Greater Austin Area Workforce Board

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Introduction

The overall aim of the Critical Skill Shortages Project is to better align the workforce development system with economic development efforts in Austin. The guiding vision is that improving the preparation and qualifications of local residents to work in the new jobs being created will help foster both economic development and the well being of Austin residents.

Both Austin and the State of Texas have pursued a cluster-based approach to economic development. In 2004, the Greater Austin Chamber of Commerce (GACC) raised $13 million in private funds through its "Opportunity Austin" campaign to finance a five-year economic development effort targeting nine industry clusters:

1. Automotive Manufacturing
2. Biosciences, including biomedical, and pharmaceutical products
3. Product Manufacturing
4. Wireless Technology
5. Transportation and Logistics
6. Computer Software
7. Clean Energy
8. Semiconductors
9. Digital Media

In a previous report (Glover et al, 2005), we assessed the nine industry clusters targeted by the GACC according to their labor market suitability and their potential for industry engagement. On the basis of this assessment, we chose two industry clusters for further work: biosciences/ biomedical/ pharmaceutical products and wireless technology. Both are emerging clusters, populated by small firms, and characterized by fast-changing technologies. About 100 firms in each cluster are located in the Greater Austin area. Both hold promise for significant development in Austin.

After securing approval from our *Work*Source Board advisors, we have conducted further investigation of the biosciences and wireless technology clusters. This report summarizes our findings to date on the labor market in biotechnology/biomedical/ pharmaceutical products in Austin.

Framing the Issues

We start by briefly attempting to frame the issues within which we are examining occupational skill shortages in these clusters.

Shortages, in one way or another, can all be traced to problems in at least one of three areas:

> **Training "fit"** – the match between employer needs and available training, in terms of the content of the training. This may include the correct knowledge base, the right skills taught, or even the way the training is provided. In several cases, employers cited insufficient applied knowledge or experience with hands-on skills.
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> **Training capacity** – whether there are enough training slots available to meet the needs. Training capacity may include slots in 4-year colleges, 2-year colleges, trade schools and programs, continuing education classes, customized training, and even a company's own capacity to provide in-house training and on-the-job training.
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> **Training utilization** relates to the question "If we build it, will they come?" In some cases, employers may consider the training to be good, and there are sufficient training slots, but the program does not attract enough qualified applicants, or those applicants who enter training do not complete the program and thus do not gain the skills needed for the jobs.

Within each of these areas, there are different types of associated root causes. For problems with **training fit**, there may be communication and feedback mechanisms between industry and the workforce development community that are either missing or misconnecting, the information links may lack clarity, or workforce developers must adhere to program guidelines or requirements that do not match the needs of employers. For problems with **training capacity**, there may be a shortage of instructors or facilities due to competing demands for those resources. For problems with **training utilization**, there may be insufficient information about the employment opportunities or the training available, negative perceptions about the jobs or the training, insufficient wages or incentives to attract trainees, or barriers to entry or to complete the training, such as problems with training schedules, child care or transportation that preclude participation of applicants in the training.

There are also several larger conceptual considerations that merit attention.

First, there appears to be an inherent *clash of cultures* between economic and workforce development practitioners. Economic development tends to put its faith in markets' ability to work out the details after an initial assist through public sector incentives or outreach. The concerns that occupy workforce development—including which occupations might be critical for a given cluster to flourish, how local residents might best be prepared for these jobs, how long the process of preparing the workforce might take, and where the financing for it might come from—are found in these "details." Effective and timely preparation of local residents often requires considerable planning and investment of public and private resources. A "market approach" may take years to accomplish, during which time local residents will not be prepared for jobs, so companies will incur added costs to recruit out-of-town candidates.

Second, the *underlying assumption* of the Critical Skills Project may or may not hold up in practice. The assumption is that the regional success of these clusters depends on effectively addressing current or projected critical skill shortages that are operating as barriers to further growth. However, there may well be other more immediate 'root causes' that serve to constrain these clusters, ones that are as critical to success as skill shortages. A prime example of this is Michael Dell's announcement several years ago that infrastructure inadequacies, specifically Austin's underdeveloped set of roads, and not shortages of workers with the appropriate skills or work attitudes, had led Dell Computer to limit its growth in Central Texas and direct it to its plants in Tennessee, Ireland and Asia. Addressing such problems may well be at least as important for the success of these clusters in the region as skill shortages and may require the collective efforts of a wider array of decision-makers in the private sector and several levels of government as well.

A third and closely related issue is that *labor market processes are increasingly non-linear*. Labor economists once could clearly articulate the "career ladders" that workers could use to advance within a given employer or industry if they obtained the requisite education, skills and experience. In today's labor markets, this is no longer the case. Several as yet imperfect metaphors are emerging to describe and understand the way labor markets work. Two such metaphors—the "career lattice" and the "climbing wall"[1]—suggest that progression may require some sideways or even downward movement for workers at times as they navigate today's labor markets. This implies that there may also be related non-linear "work-arounds" for potential skill shortages, such as skill training at the community college level for graduates of 4-year colleges who have the knowledge but not the skills or experience in applying their knowledge.

To the extent that skill shortages act as a barrier to further growth in the targeted clusters, it is far more likely in industry clusters where the preparation process for highly skilled professional and technical workers is much longer and more elaborate. Biosciences generally fit this mold much more so than Wireless. In Biosciences, large shares of the workforce will necessarily require college academic training, some of it at the postgraduate level, while most of the key workers in Wireless may only need industry experience or technical certification. We presume that both the root causes and the associated solutions to any identified skill shortages in these clusters will look quite different.

Cluster-driven Economic Development

Regional economies are composed of three main types of activities: natural resources clusters, local clusters, and traded clusters. *Natural resource clusters* are found in regions where a particular natural resource is abundant. *Local clusters* are found in every region and produce goods and services that are needed by the local population, e.g., retail trade, or hospitals and medical facilities that serve the local population. *Traded clusters* in a region produce goods and services that are in competition with other regions and nations. They trade across the nation and even the globe (e.g. automotive parts, medical devices). These clusters tend to be concentrated only in a few regions.

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[1] For more on this topic, see: David W. Stevens, "Welfare to Work Policy," Baltimore, MD: The Jacob France Institute, University of Baltimore, July 2001. This is a revised version of a paper presented to *America's Workforce Network Research Conference* in Washington, D.C. on June 27, 2001.

Traded clusters drive regional prosperity. While local clusters account for roughly two-thirds of employment in an average region, traded clusters drive the prosperity and growth of the region. This is because traded clusters can achieve higher productivity, their growth is unconstrained by the size of the local markets, and their success creates much of the demand for local clusters (Porter 2002). Traded clusters bring new value to a region rather than simply shifting value within a region.

Thus, our primary interest in this study is traded clusters. In biosciences, this does not include hospitals and health care facilities or medical labs that serve only the local population.

The Bio Cluster – what does it encompass?

The bioscience/biomedical cluster encompasses a wide variety of enterprises, including the following:

Biotechnology is the use of biological processes to solve problems or make useful products. Biotechnology involves the use of microorganisms, such as bacteria or yeasts, or biological substances, such as enzymes or genes, to perform specific industrial or manufacturing or medical processes. Applications include the production of certain drugs, synthetic hormones, and bulk foodstuffs as well as the bioconversion of organic waste and the use of genetically altered bacteria in the cleanup of oil spills. Also included is the use by industry of recombinant DNA, cell fusion, and new bioprocessing techniques.

Biomedical Products/Medical Devices include firms manufacturing products such as syringes, hypodermic needles, surgical instruments, wheelchairs, ECG devices, hip prostheses, operating tables, dental equipment, dental instruments, condoms and much more. Medical devices also include more specialized products such as pacemakers and other implants with a power source. In other words, medical devices are all products used for diagnosing, treating and helping sick people, except for medicinal products.

Bioinformatics is the science of informatics as applied to biological research. Informatics is the management and analysis of data using advanced computing techniques. Bioinformatics is particularly important as an adjunct to genomics research, because of the large amount of complex data this research generates.

Pharmaceutical Products are health products, which contain synthetically produced compounds not found in nature. Pharmaceutical health products are found in a prepared dosage form. Producers of these products are permitted to make claims regarding structure/function, risk reduction and treatment. Pharmaceutical health products are regulated by health product legislation.

The Biosciences/Biotechnology/Biomedical Products Cluster in Austin

Austin has a growing variety of bioscience firms that trade nationally or globally. Bioscience products made in Austin range from biomedical devices such as heart valves (Medical Carbon Research Institute, Carbomedics), hospital products (Abbott Labs), spinal implants

(Abbott Spine), stem cell storage bags (OriGen Biomedical), diagnostic testing systems (Luminex), and laboratory analysis instruments for veterinarians (Seahawk Biosystems). Austin biotechnology firms also provide services such as drug testing and employee screening services (DTS Austin), and several produce innovative products used by scientific researchers, such as custom-produced RNA solutions for scientific research (Ambion, Inc.) or mutagenesis kits used in cloning studies (Stratagene). Austin is also home to a concentration of firms that conduct clinical trials (CEDRA Corporation, PPD Development, Quintiles Transnational, and Scirex Corporation, and INC), and firms that produce clinical decision support software and other informatics tools (Caducian, Inc.).

One notable characteristic of the biosciences industry in Austin is its heavy use of staffing agencies to perform human resource functions on an outsourced basis. Many of these firms have excellent networks and contract with bioscience firms to provide a range of services, including making arrangements and handling the benefits for temporary staff, interns, temp-to-hire employees, permanent hires, and executive search. Kelly Scientific is a primary staffing agency for biosciences in Austin.

The Outlook for Economic Development: Poised for Growth?

Employment predictions commonly used in workforce development are necessarily projected from past performance trends. Yet economic development efforts aim to improve on past performance—to change the trend lines.

Table 1: Location Quotients for Travis County in Biosciences/Biomedical/Pharmaceutical Industries: 2004

Industry	Travis County, Texas
Base Industry: Total, all industries	1.00
NAICS 3254 Pharmaceutical and medicine manufacturing	1.50
NAICS 333314 Optical instrument and lens manufacturing	ND
NAICS 334510 Electromedical apparatus manufacturing	ND
NAICS 334516 Analytical laboratory instrument mfg.	NC
NAICS 334517 Irradiation apparatus manufacturing	ND
NAICS 3391 Medical equipment and supplies manufacturing	1.15
NAICS 42345 Medical equipment merchant wholesalers	0.56
NAICS 42346 Ophthalmic goods merchant wholesalers	0.31
NAICS 42421 Druggists' goods merchant wholesalers	0.53
NAICS 54171 Physical, engineering and biological research	1.66
NAICS 54172 Social science and humanities research	1.33
NAICS 6215 Medical and diagnostic laboratories	1.54

Source: calculated from Quarterly Census of Employment and Wages Data: 2004

Footnotes:
(ND) Not Disclosable
(NC) Not Calculable, the data does not exist or it is zero

Location Quotient: Ratio of analysis-industry employment in the analysis area to base-industry employment in the analysis area divided by the ratio of analysis-industry employment in the base area to base-industry employment in the base area.

Available employment numbers in the traded sectors of Austin's bioscience/biomedical and pharmaceutical products cluster show a decline from 2001 through 2004 (see Appendix A). Some of the decline was attributable to the 2004 phase out of Zimmer (formerly Centerpulse) orthopedic device manufacturing facilities. As measured by Location Quotients (LQ) in the various traded sectors associated with bioscience, Austin scored above the national average in the research sectors and in Pharmaceutical and medicine manufacturing (NAICS 3254) and slightly above the national average in Medical equipment and supplies manufacturing (NAICS 3391). This means that Austin had a higher than average concentration of employment in these sectors compared with other labor markets.

Judging solely on the basis of all these numbers, this cluster offers mixed prospects for future job creation. However, the future need not resemble the past.

Texas has targeted biotechnology as part of both the Governor's Industry Cluster Initiative and the State Strategy on Advanced Technology. Three state funds are now established to promote and help finance economic development: the Texas Emerging Technology Fund ($200 million), the Texas Enterprise Fund ($180 million) and CAPCO, a pool of private venture capital administered by the Comptroller of Public Accounts and funded by Insurance Premium Tax Credits.

The Texas Healthcare and Bioscience Institute, a statewide organization, has been strongly advocating for increased funding for biosciences. On July 16, 2005, the largest grant from the Texas Enterprise fund was announced for a joint venture between Texas A&M University and Lexicon Genetics to help establish a nonprofit Texas Institute for Genomic Medicine. In addition, a new statewide Regional Center of Innovation and Commercialization focused on biotechnology soon will be located in Austin, providing virtual access across the state.

The Greater Austin Chamber of Commerce likewise has targeted the biosciences cluster and is actively recruiting new firms and promoting the expansion of existing firms. In 2004, the Greater Austin Chamber of Commerce published a listing identifying 106 firms in biosciences (GACC).

Scientific research is the most powerful driver of the biotech economy, and university support is critical in this process. A recent study in California concluded that scientists working at universities or research institutes have founded nearly half of all venture-backed startups (Zhang and Patel, 2005). Further, the study found that university faculty generally preferred to locate these startups nearby.

The University of Texas at Austin has established the Office of Technology Commercialization, aimed at getting UT innovations into the marketplace. The prospective increase in intellectual property (IP) from all this activity is anticipated to bring new and expanded commercialization prospects to Austin. The increased emphasis on research and innovation will likely bring growing needs for skilled workers to help implement and commercialize the new opportunities.

Dramatic recent increases in research capacity and student enrollments at the University of Texas have brought greater emphasis on biosciences. In 2002, the University of Texas created a new Institute in Cellular and Molecular Biology. Other related research facilities include the Biochemical Institute, the Center for Biological and Medical Engineering, the Center for Nano and Molecular Science and Technology, the Institute for Computational Engineering and Sciences, the Institute for Neuroscience, and the Institute for Theoretical Chemistry. Efforts are underway to locate a new medical school campus in Austin, and joint research programs have already been established between the UT biochemistry department and the new medical school entity.

Austin's biosciences industry is gaining national recognition. In 2004, the Milken Institute included Austin in its rankings of the top 12 biotech and life science centers in the nation, based on the biotechnology innovation pipeline and economic outcomes of the biotech sector (DeVol, et al., June 2004)

Workforce Development– Education and Training in Biosciences

Bioscience firms place great emphasis on academic credentials in their hiring practices. In pharmaceutical and medicine manufacturing, for example, 6 out of 10 workers have a bachelor's, master's, professional, or Ph.d. degree—more than twice the proportion for all industries combined. Almost all workers in research and development activities have a baccalaureate degree or more advanced degrees. However, there is a need for workers with applied skills and less formal education as well, especially when the process moves out of research and development phases into production and distribution.

University-level Preparation

At the University of Texas, student enrollment in chemistry, pharmacy and life sciences has recently increased dramatically. In 2004, the University conferred bachelors, masters or doctoral degrees on 1056 students—a 20 percent increase over four years (see Table 2). In addition, biomedical engineering became a full department in 2001, adding seven faculty members, and began an undergraduate program which now has more than 325 students enrolled. Its first class will graduate in spring 2006.

Staff at the UT Career Services in the College of Natural Sciences confirms that the first choice of the majority of their graduates is to remain in Austin–if they can find a good job. Local biotechnology firms report that they also find it is easy to recruit scientists and college-educated workers to live and work in Austin. It appears that a large pool of workers with bachelors degree or higher will be available to expanding firms in the biotechnology and biomedical industries.

Table 2: Statistics on Degrees Conferred at University of Texas, Austin: 2000-2004

College / Department / Major	Degree Conferred	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
ENGINEERING						
Biomedical Engineering	B	-	-	-	-	-
	M	6	9	16	13	14
	D	3	4	3	5	2
	Total	9	13	19	18	16
Chemical Engineering	B	133	115	101	114	109
	M	16	22	19	15	19
	D	18	22	16	24	20
	Total	167	159	136	153	148
NATURAL SCIENCES						
Biological Sciences	B	292	285	324	415	536
	M	3	4	1	0	0
	D	11	6	4	2	5
	Total	306	295	329	417	541
Molecular Biology	M	2	5	3	3	2
	D	7	9	10	8	9
	Total	9	14	13	11	11
Cell & Molecular Biology	M					
	D			1	0	0
	Total			1	0	0
Microbiology	B	71	91	53	46	29
	M	0	3	3	4	2
	D	1	7	5	5	3
	Total	72	101	61	55	34
Biochemistry	B	84	76	68	76	76
	M	2	0	2	1	1
	D	5	5	1	4	3
	Total	91	81	71	81	80
Chemistry	B	43	37	57	56	44
	M	8	3	7	18	7
	D	32	27	28	29	28
	Total	83	67	92	103	79
Clinical Lab Science (1)	B	8	3	7	10	7
	Total	8	3	7	10	7
PHARMACY	B	21	12	2	0	
	M	17	9	15	9	6
	D	10	11	19	12	12
	Pharm. D. (2)	82	117	115	108	122
	Total	130	149	151	129	140
All Majors	**Grand Total**	875	882	880	977	1,056

U = Undergraduate M = Master's D = Doctoral Pharm. D. = Doctor of Pharmacy T = Total
B = Bachelor's M = Master's D = Doctoral Pharm. D. = Doctor of Pharmacy T = Total

(1) Beginning in spring 2001, the existing Bachelor of Science in Medical Technology became Clinical Laboratory Science

(2) Beginning in fall 1997, Pharm. D. became a separate program from the Graduate School.

Source: Reports of Degrees Conferred as compiled by the Office of the Registrar, the Deans of the Schools and Colleges, and the Office of Institutional Research.

Community College Preparation

The picture at Austin Community College (ACC) is mixed. ACC has a strong program in biotechnology, but little else is in place yet.

Austin Community College began a new department in biotechnology in 1999, offering a five-semester associate of applied science degree and a one-year certificate. The ACC biotechnology program also administers the six-state South Central region for BIO-LINK, a national Advanced Technological Education Center for Biotechnology, funded by the National Science Foundation (NSF). As part of the BIO-LINK network, the ACC program chair has been able to scout the nation for best practices in biotechnology education and build them into the new biotechnology programs at ACC.

The ACC biotechnology programs are connected through Tech Prep articulation agreements with teachers and students in eight area high schools. Under this arrangement, students are eligible to gain college credit for their learning in high school.

ACC's biotechnology programs are well connected with individual Austin–area employers. Two employees with Ambion serve as part-time adjunct faculty in the programs. The programs have a strong industry advisory committee representing a variety of biotechnology fields. The ACC Biotechnology facilities are new and well equipped. All students participate in a required "capstone" internship near the end of their program of study, which often offers them a gateway to permanent employment. Indeed, the program's director reports that 100 percent of the graduates of the program have been placed, nearly all with Austin firms.

ACC's programs in biotechnology are rigorous. They require that students take prerequisite courses in intermediate algebra, biology and chemistry. Attrition in the program is quite high; on average 50 percent of the students fail the initial course, "Introduction to Biotechnology."

Moreover, seventy percent of the students enrolled in the programs reportedly already have a bachelor's degree. In a real sense, ACC's biotechnology department operates as a post-baccalaureate program to give college graduate science majors the technical skills they need to work in biotechnology. ACC biotechnology faculty also offer Continuing Education and on-line courses that are taken by four-year college students and others. In addition, ACC Continuing Education contracts with local firms to train incumbent employees.

Difficult-to-fill Occupations and the Skills Required

This section reports on difficult-to-fill occupations with a special (although not exclusive) emphasis on occupations that do not require a baccalaureate degree. Industry representatives and data did not support a finding of shortage occupations as much as identifying occupations that employers found difficult to fill; hence the adjustment in terminology. Information for this section came from company interviews, from a focus group discussion held at the Greater Austin Chamber of Commerce, as well as from scans of job postings on company websites, on WorkInTexas, and on Monster.com during July 2005 (see Appendix C). Key points from this review are as follows:

- Many jobs are difficult to fill from local Austin sources. These include jobs for top managers and marketing personnel, but also surprisingly, jobs at the "line worker" level requiring associate degrees. While there were no detectible current or near-term projections for widespread occupational shortages in Austin's bioscience industries, firms acknowledged their need to recruit talent from outside of Austin to fill positions.

- Recent college graduates are abundant, but many lack work experience and required technical skills.

- Firms in this cluster don't project their workforce needs beyond one year.

At the baccalaureate level and above

Medical devices manufacturers need high-level talent such as project managers, marketing staff and specialty design engineers. They conduct national searches to find them.

In pharmaceutical products, there are needs for experienced compounders who can assemble and mix the ingredients in batches of medicine, following proper protocols, quality assurance and documentation procedures.

Clinical trial research firms need applicants with nursing degrees and bachelors' degrees to work as Clinical Trial Managers and Clinical Research Coordinators. Employers conducting clinical trails hire analysts with bachelors' degrees who are familiar with research protocols and government regulations and can run queries and check for discrepancies in databases. These analysts need to be familiar with SAS software, database management, and data validation procedures.

At the sub-baccalaureate level

Fifteen of the 63 bioscience jobs (24%) found posted on Monster.com required an associate's degree and/or relevant experience (see Appendix C).

Employers in biotechnology need certain types of laboratory technicians, production technicians, laboratory assistants, and shipping associates. Generally, the skills needed for most of these positions include knowledge of regulations, biological processes and scientific research procedures, good clinical practices, good laboratory practices, familiarity with quality control and quality assurance, and computer and data management skills and written communication skills to document the findings or processes.

In clinical trial research, employers need Clinical Trial Assistants, who support the work of teams planning and implementing clinical trials.

A manufacturer of heart valves reported difficulty in finding workers willing to work all day using microscopes, checking for flaws, polishing, and assembling heart valves. Entry-level pay for such jobs ranges from $10 to $12 per hour. The nature of this work may have deterred some applicants from applying. The employer remarked that workers at various local computer and semiconductor manufacturers conduct similar work using microscopes; but he acknowledged that workers with any seniority were paid more than the entry wage at his firm.

Discussion

As bioscience industries grow in Austin, these needs are likely to increase. Unlike biotech centers such as Raleigh, New Jersey, or San Diego, Austin does not have a deep pool of workers at a variety of levels of experience and formal education in biosciences. Gaps between supply and demand will not be quickly or easily addressed because the skills take time to acquire and generally require a base of academic credentials. For example, for technician positions, most employers prefer applicants who have at least two years of specialized training or an associate degree.

Some industry officials expressed concern about potential shortages of workers developing at mid-to-lower technical skill levels, which require an associate's degree or equivalent experience. These jobs account for about 15 percent of all jobs in the biosciences. As one respondent characterized the situation: "Austin lacks skilled worker bees."

Root Causes for the Shortages and Shortcomings in Skills

The shortcomings in skills at the university level noted by employers can be generally classified as "lack of fit" or mismatch issues. At the community college level, the problem is lack of capacity or–in the case of biotechnology programs–underutilization.

For jobs requiring university-level preparation

Austin has a plethora of fresh college graduates in science, but they are not interested in entry-level jobs without clear prospects of "suitable careers."

> ***Lack of fit***–Several employers interviewed complained about shortcomings in the applied skills of four-year college graduates. College graduates know theory but are often unable to apply what they know. Employers complain that college graduate biology and chemistry majors are unfamiliar with research protocols and with regulations–vitally important in an industry that requires Federal Drug Administration (FDA) approvals.
>
> ***False expectations***—Many college students aim to enter medical or veterinary school. When they are not admitted, they don't know what other employment may be available to them as science majors. Other college graduates apply to employers expecting to be hired directly as managers, not realizing that they have to start at the bottom and work their way up.

For jobs requiring community college preparation

> ***Underutilization of training***–Austin does not produce enough graduates at the associate-degree level. In one area, this is a problem of underutilization. ACC has an excellent program for preparing "wet bench lab" workers in biotechnology, but it is underutilized. The program currently operates with an enrollment at less than half of its capacity. In addition, ACC's academic programs in biology and chemistry confer only a handful of associate degrees each year (see Table 3).

Table 3. Statistics on Student Populations in Austin Community College Programs Related to Bioscience

Biotechnology	**1999-2000**	**2000-2001**	**2001-2002**	**2002-2003**	**2003-2004**
Course enrollment (fall)	24	29	35	47	35
Semester Credit Hours (fall)	85	103	132	154	106
AAS Degrees Awarded	-	0	6	9	5
Certificates Awarded	-	2	2	0	0
Biology					
AS Degrees Awarded	2	6	0	1	2
Chemistry					
AS Degrees Awarded	1	1	0	1	2

Source: Austin Community College, Fact Book, 2004-2005

Definitions:

Course Enrollment-the number of students enrolled in a course. Duplicated enrollment occurs when a student is counted more than one time because they are enrolled in more than one course.

Semester Credit Hours-defined as one clock hour of class per week.

Degrees and Certificates Awarded-defined as the number of degrees and certificates awarded over the entire school year.

NOTE: these figures do not include enrollments in continuing education or on-line courses.

Despite extensive efforts to recruit high school students for the biotechnology program through Tech Prep articulation agreements with eight area high schools since 1998, the program has experienced difficulty in attracting students. Most students with a good high school background in science and mathematics prefer to enter a 4-year college, and parents weigh in heavily to favor this decision. In addition, the relative lack of visibility of the biotechnology industry in Austin (as compared with computer technology or nursing, for example) contributes to this situation. Relatively low entry-level wages available to graduates may also deter students.

The chair of the biotechnology department reports that she has had greater success in recruiting adults in ACC biology and chemistry classes and in recruiting foreign students through English-as a-Second Language (ESL) classes.

Lack of training capacity. Other jobs lack formal training programs at all. For example**,** Clinical Trial Assistants are paid $10-$12 at entry. With experience, they can earn up to $35,000 per year. Yet the only way available currently in Austin to learn this job is through on-the-job training. Such training could be offered through Continuing Education at ACC, but it is not currently.

Likewise, training is not as yet available for production and maintenance technicians in Austin's biomedical devices industry. Texas State Technical College (TSTC) in Waco will begin a new program for Biotechnology Instrumentation Specialists in fall 2005. Firms from the biomedical devices industry have approached the Electronics Department at ACC to request establishing a specialization in biomedical instrumentation and one in biotechnology instrumentation; but to date, the Department has resisted for fear of insufficient student enrollment to sustain the programs. Under consideration now is a consolidated program that combines biomedical and biotechnological instrumentation, with medical instrumentation. The proposed program may become a joint venture with TSTC, which can offer courses in lasers and optics not currently available at ACC.

Building capacity within community colleges is important because Austin's small firms in biosciences often struggle to find the time or resources to conduct the training internally.

Contributing factors to Skill Shortcomings and Shortages

Continual change

Continual change–in markets, in technologies, and in processes–is a feature of the emerging biosciences cluster. The bioscience cluster is in constant ferment; indeed, some of the firms listed in 2004 by the Greater Austin Chamber of Commerce are no longer in business. This environment demands workers who are continually learning and adapting. The high likelihood of career changes throughout life requires the ability to adapt. Job applicants need to stay current as well; technological obsolescence can be a barrier to getting a job. For example, firms that conduct clinical trials reported encountering difficulties filling jobs on their data management teams because job applicants are not familiar with up-to-date software, such as the Oracle applications currently used in clinical trials.

Myths and misconceptions about 2-year and 4-year schools

Many employers do not view community colleges as able to perform the advanced training they require.

Lack of awareness about biotechnology

The fact that Austin has significant capabilities in biotechnology is not widely appreciated by the general community. Biosciences in Austin lack any public marketing effort, such as the recent campaign in North Carolina to promote the industry through short public service announcements. Clear information about bio-related occupations at various levels, skill needs, or training other than baccalaureate level (and above) is not readily available in Austin.

No vehicle for industrywide networking

Austin lacks a mechanism that allows people from across the industry to come together for peer-to-peer exchanges. The networking efforts that do exist through the Greater Austin Chamber of Commerce and the San Antonio Austin Life Sciences Association (SALSA) attract mostly top executives. Such vehicles do exist in other cities, such as San Diego's BIOCOM.

There is no bio-related communications mechanism or network in the Austin area between industry and workforce development. Education and training programs build individual relationships with potential employers, but information is not available systemwide.

Workforce and economic development industry categories don't match

Austin's biosciences cluster includes diverse segments, and job applicants may be unaware of their options and opportunities in this cluster. A job seeker searching through WorkInTexas would not find any category identified as "biosciences" or "biotechnology." Rather jobs in biosciences are subsumed under a larger category of "Life, Physical and Social Sciences." Jobs in medical device firms might be found under "production occupations," biotechnology and clinical trials jobs would be part of "health care practitioners and technical," and bioinformatics may be part of "computer and mathematical."

Assessment and Tentative Recommendations

The research process, including interviews, a focus group, review of comments by industry representatives received in response to distribution of a preliminary assessment on the Chamber's bio listserve, and other assessment, produced the following ideas for exploration that could potentially lead to solutions:

- Include more development of practical skills and applications in the educational process. Post-baccalaureate training can teach college graduates practical skills and applications. Internships can often bridge this gap by giving college students practical job experience.

- Expand and improve training options that can be mounted quickly to fill specific needs through better utilization of ACC's customized contract training and continuing education.

- Develop a bioscience network for the Austin area to help organize the industry and provide visibility, much as BIOCOM does for San Diego. Emphasis should be on action, results, and potential benefits. This effort should build on existing endeavors, such as the Texas Healthcare and Bioscience Institute (THBI), the ACC Biotechnology Industry Committee, and the industry partners of the UT Biomedical Engineering Program.

- Expand community college learning opportunities. If Austin is to capitalize on its production of scientific research and talent, it will need to focus on skill development across the full spectrum—not just high-end university-level science. To be able to commercialize opportunities and establish manufacturing here, Austin needs to develop a workforce able to perform a broad range of technical skills. In-house and on-the-job training will continue to be necessary elements of workforce development. But, given the heavy need for academic preparation, public training institutions, especially Austin Community College, has important roles here as well. Industry needs to find effective ways to communicate their needs to ACC and to provide assistance with loaned teachers and student and faculty internships.

- If Austin and the state of Texas want to foster economic development in biotechnology and bioscience, the workforce system needs a counterpart emphasis. Presently, the computer job matching program, WorkInTexas.com is not sufficiently "user-friendly" to either employers or job applicants in biosciences. Jobs in biosciences are subsumed

under a larger category of “Life, Physical and Social Sciences” and cannot be isolated directly. In contrast to WorkInTexas.com, the website, Monster.com, offers a category of job postings entitled “Biotechnology and Pharmaceutical.” Since Texas is targeting biotechnology as part of its economic development efforts, the state could make it easier for employers and jobs applicants in this industry to find one another.

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Appendix A
Labor Market Statistics on Biosciences/ Biomedical and Pharmaceutical Products

Travis County

A-1: Biosciences Biomedical and Pharmaceutical Products Number of Establishments — 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	8	8	6	7
333314	Optical Instrument and Lens Manufacturing				
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	52	48	54	37
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	35	41	41	42
42346	Ophthalmic Goods Merchant Wholesalers			3	4
42421	Drugs and Druggists' Sundries Merchant Wholesalers	17	15	18	19
44611	Pharmacies and Drug Stores	69	74	74	75
44613	Optical Goods Stores	35	32	33	39
54171	Research and Development in the Physical, Engineering, and Life Sciences	76	80	68	81
54172	Research and Development in the Social Sciences and Humanities	25	24	25	28
541940	Veterinary Services	87	89	89	97
6215	Medical and Diagnostic Laboratories	32	30	34	37

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix A
(continued)

Travis County

A-2: Biosciences / Biomedical and Pharmaceutical Products
Average Employment — 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	1,610	1,640	1,644	1,609
333314	Optical Instrument and Lens Manufacturing				
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	1,644	1,437	1,360	1,243
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	215	260	271	362
42346	Ophthalmic Goods Merchant Wholesalers			20	25
42421	Drugs and Druggists' Sundries Merchant Wholesalers	439	430	435	435
44611	Pharmacies and Drug Stores	1,505	1,541	1,509	1,579
44613	Optical Goods Stores	229	235	191	209
54171	Research and Development in the Physical, Engineering, and Life Sciences	3,368	3,291	3,032	3,075
54172	Research and Development in the Social Sciences and Humanities	413	399	304	321
541940	Veterinary Services	986	1,010	998	1,071
6215	Medical and Diagnostic Laboratories	984	1,015	1,187	1,121

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix A
(continued)

Travis County

A-3: Biosciences/Biomedical and Pharmaceutical Products
Average Weekly Wages, 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	$1,036	$1,051	$1,053	$1,221
333314	Optical Instrument and Lens Manufacturing				
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	$971	$993	$1,708	$1,223
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	$1,549	$1,657	$1,579	$1,982
42346	Ophthalmic Goods Merchant Wholesalers			$1,508	$1,544
42421	Drugs and Druggists' Sundries Merchant Wholesalers	$1,300	$1,395	$1,396	$1,576
44611	Pharmacies and Drug Stores	$455	$489	$502	$554
44613	Optical Goods Stores	$489	$525	$619	$636
54171	Research and Development in the Physical, Engineering, and Life Sciences	$1,262	$1,190	$1,233	$1,274
54172	Research and Development in the Social Sciences and Humanities	$1,005	$1,117	$1,093	$1,247
541940	Veterinary Services	$562	$587	$584	$631
6215	Medical and Diagnostic Laboratories	$1,063	$1,140	$1,128	$1,200

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix A
(continued)

MSA Austin-Round Rock

A-4: Biosciences/ Biomedical and Pharmaceutical Products
Number of Establishments, 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	11	11	10	12
333314	Optical Instrument and Lens Manufacturing	3	3	3	3
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				3
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	62	57	63	46
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	42	48	49	51
42346	Ophthalmic Goods Merchant Wholesalers		4	4	5
42421	Drugs and Druggists' Sundries Merchant Wholesalers	24	21	24	24
44611	Pharmacies and Drug Stores	106	111	114	120
44613	Optical Goods Stores	45	40	44	50
54171	Research and Development in the Physical, Engineering, and Life Sciences	86	90	83	94
54172	Research and Development in the Social Sciences and Humanities	25	24	25	28
541940	Veterinary Services	140	147	152	163
6215	Medical and Diagnostic Laboratories	37	34	40	44

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix A
(continued)

MSA Austin-Round Rock

A-5: Biosciences/Biomedical and Pharmaceutical Products
Average Employment, 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	1,684	1,711	1,824	1,783
333314	Optical Instrument and Lens Manufacturing	40	42	42	53
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				13
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	1,946	1,782	1,664	1,529
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	288	327	346	437
42346	Ophthalmic Goods Merchant Wholesalers		24	22	26
42421	Drugs and Druggists' Sundries Merchant Wholesalers	590	573	604	459
44611	Pharmacies and Drug Stores	1,984	2,013	2,016	2,143
44613	Optical Goods Stores	278	264	251	290
54171	Research and Development in the Physical, Engineering, and Life Sciences	3,435	3,327	3,077	3,135
54172	Research and Development in the Social Sciences and Humanities	413	399	304	321
541940	Veterinary Services	1,565	1,615	1,686	1,730
6215	Medical and Diagnostic Laboratories	1,010	1,043	1,220	1,155

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix A
(continued)

MSA Austin-Round Rock

A-6: Biosciences/ Biomedical and Pharmaceutical Products
Average Weekly Wages, 4th Quarter

NAICS	Description	2001	2002	2003	2004
3254	Pharmaceutical and Medicine Manufacturing	$1,048	$1,070	$1,082	$1,234
333314	Optical Instrument and Lens Manufacturing	$1,035	$1,329	$975	$900
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing				
334516	Analytical Laboratory Instrument Manufacturing				$871
334517	Irradiation Apparatus Manufacturing				
3391	Medical Equipment and Supplies Manufacturing	$964	$937	$1,740	$1,165
42345	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	$1,482	$1,569	$1,543	$1,842
42346	Ophthalmic Goods Merchant Wholesalers		$1,561	$1,393	$1,489
42421	Drugs and Druggists' Sundries Merchant Wholesalers	$1,340	$1,501	$1,616	$1,585
44611	Pharmacies and Drug Stores	$452	$491	$520	$568
44613	Optical Goods Stores	$487	$530	$599	$585
54171	Research and Development in the Physical, Engineering, and Life Sciences	$1,265	$1,191	$1,236	$1,273
54172	Research and Development in the Social Sciences and Humanities	$1,005	$1,117	$1,093	$1,247
541940	Veterinary Services	$518	$549	$568	$597
6215	Medical and Diagnostic Laboratories	$1,053	$1,129	$1,121	$1,193

Source: Texas Workforce Commission, Labor Market Information, TRACER, Quarterly Employment and Wages (QCEW)

Appendix B
Job Postings, Biotechnology and Pharmaceutical
(www.monster.com. July 2005) Austin

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
1	6/30	On Assignment	Laboratory Technician Opportunities	AS Degree in Chemistry, Chemical Technology, Biology or Biotechnology	Recent industry experience in a laboratory environment	R	Tech1			
2	6/29	Kelly Scientific Resources	Clinical Research Administrative Assistant	Bachelor's Degree or equivalent combination of education, training, and experience	1-2 years of experience in a research, academic, pharmaceutical, or other scientific environment	R	B/M/A			10 to 12 per hour
3	6/27	Kelly Scientific Resources	Molecular Biology Lab Technician	BS in Molecular Biology or related field is preferred	Experience with DNA, RNA, PCR, sequencing, purification, and amplification is desired and may substitute for education	R	Tech1	Entry Level		15 to 17 per hour
4	6/25	Scirex Corporation	Clinical Assistant	High School diploma with one year direct clinical research experience and relevant Associates Degree in Health Science or Medical Assistant certification	Two years experience as a Medical Assistant (or equivalent)	R	R/A	Temporary / Contract / Project	Per Diem	
5	6/22	Ambion Inc	Shipping Associate	High School or equivalent	1+ to 2 Years	R	A/D	Entry Level	FT/1st(Day)	

*US-TX-Statewide
R= Relevant for WorkSource,P= Possibly relevant, N=Not Relevant
Tech1=LabTechnician,Tech2=CustomerSupportTech,R/A=Researcher/Analyst,A/D=Assembly/Distribution,B/M/A=Business/Marketing/Administration,
E/Mgr=Executive/Manager,O=Others

Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
6	6/21	Quintiles Transnational	Clinical Trials Manager	Prefer RN, BSN, BS/MS or BA or Associates degree or high school diploma or equivalent and 8 or more years of relevant experience in a health related field	4-5 years related clinical research experience with Bachelor's Degree or 5-6 years related experience in health related field with AS Degree, or high school diploma or equivalent and 8 or more years of relevant experience in a health related field	R	B/M/A	Entry Level		
7	6/9	PharMerica	Certified Pharmacy Technician	High School Diploma or equivalent experience	0 to 6 mo. of related experience in long term care, retail, hospital or mail delivery	R	Tech1			
8	6/2	Clin Force	Regional Clinical Research Associate	Associates Degree	Minimum of 1.5 years regional site monitoring experience	R	R/A		FT	
9	6/1	Ambion Inc	Production Technician-Second Shift	High School or equivalent	1+ to 2 Years	R	Tech2		FT/2nd(Aftnoon)	

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E/Mgr=Executive/Manager,O=Others

Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
10	5/27	Kelly Scientific Resources	Medical Technologist	Degree in Medical Technology or Clinical Laboratory Science. Recent MT/CLS grads are encouraged to apply. An ASCP certification in Medical Technology is a plus.	Training is provided	R	Tech1	Experienced (Non-Manager)		15 to 20 per hour
11	5/27	Kelly Scientific Resources	Microbiology Lab Technician	BS in Microbiology or related field. Experience may substitute for a degree.	Hands-on microbiology lab experience, including aseptic technique, tissue culture, and organism identification. A good understanding of quality control, quality assurance, and environmental/ food micro techniques is also helpful	R	Tech1	Entry Level		9 to 12 per year
12	5/27	Kelly Scientific Resources	Chemical Laboratory Technician	Bachelor's degree in Chemistry or a related field (experience may substitute for education).		R	Tech1	Entry Level		9.50 to 12 per hour
13	5/27	Kelly Scientific Resources	Medical Laboratory Technician	Associates degree in Laboratory Technology or Medical Laboratory Technology. ASCP certification is preferred, but not required.	Individuals with applicable experience or military training are urged to apply	R	Tech1	Entry Level		13 to 18 per hour

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
14	5/27	Kelly Scientific Resources	Chemical Lab Assistant	Associates degree in chemical technology or have completed at least two semesters of college level chemistry.	Relevant laboratory experience may substitute for education	R	Tech1	Entry Level		9 to 13 per hour
15	5/10	Ambion Inc	Clinical Studies Assistant		Experience Required	R	Tech1			
16	4/28	Kelly Scientific Resources	Molecular Biology Lab Technician	Bachelor's Degree	Experience may substitute for a degree.	R	Tech1	Entry Level		15 to 17 per hour
17	7/8	Management Recruiters Intntl	Applications Chemist*			P	R/A		FT	36,000 to 60,000 per year
18	7/1	CEDRA Corporation	Research Associate	Bachelor's Degree	Less than 1 Year	P	R/A	Entry Level	FT/1st(Day)	
19	6/29	Kelly Scientific Resources	Clinical Research Associate (Regional)	Bachelor's degree (scientific or nursing discipline)	2 years of field monitoring experience as a Clinical Research Associate	P	R/A			
20	6/3	Ambion Inc	Production Assistant	Bachelor's Degree	1+ to 2 Years	P	A/D	Entry Level	FT/1st(Day)	
21	5/27	Kelly Scientific Resources	Analytical Chemist	B.S. degree in Chemistry or related science	Hands-on laboratory experience using HPLC, GC, GC/MS, MS, ICP, IC, or other analytical instrumentation	P	R/A	Experienced (Non-Manager)		12 to 15 per hour

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
22	5/27	Quintiles Transnational	CRA/Sr.CRA (Officebased)	BS/BA Degree	Experience in clinical research, preferably with two years of on-site clinical monitoring experience, or equivalent combination of education, training, and experience	P	R/A	Entry Level		
23	5/27	Kelly Scientific Resources	Inorganic Chemist (ICP)	B.S. degree (Chemistry preferred)	Hands-on laboratory experience using ICP, IC, and other inorganic techniques and instrumentation	P	R/A	Experienced (Non-Manager)		12 to 15 per hour
24	5/27	Kelly Scientific Resources	Analytical Chemist (Organic)	B.S. degree (Chemistry preferred)	Hands-on laboratory experience using HPLC, GC, GC/MS, MS, or other analytical instrumentation. Prefer candidates with environmental experience in organic extractions and EPA methodology	P	R/A	Experienced (Non-Manager)		14 to 17 per hour

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
25	5/27	Kelly Scientific Resources	GMPChemist (QualityControl)	Bachelors' degree in chemistry or a related discipline.	Must have strong wet chem skills, 1-4 years of experience running HPLC in a pharmaceutical GMP environment, and strong documentation skills	P	R/A	Experienced (Non-Manager)		14 to 20 per hour
26	5/5	Scirex Corporation	SAS Programming Manager		Experience in Biotech/Health Care	P	O			
27	5/24	Scirex Corporation	Clinical Research Coordinators			P	R/A		Per Diem	
28	6/29	Kelly Scientific Resources	SAS Programmer (Pharmaceutical)		5 yrs of SAS programming experience	P	O			50,000 to 70,000 per year
29	7/14	Ambion Inc	BuyerII	Bachelor's Degree	2+ to 5 Years	N	A/D	Experienced (Non-Manager)	FT/1st(Day)	
30	7/13	Abbott Laboratories	Senior Medical Experience Analyst	Bachelor's degree and licensed as a Registered Nurse or Physician's Assistant	5 years medical practice experience in spine or orthopedic surgery (e.g. surgical nurse or equivalent) highly desired and considered ideal. 7-10 years total medical practice experience preferred (3-5 years of this experience must be supporting or participating in orthopedic surgery).	N	R/A		FT	

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
31	7/13	Quintiles Transnational	Senior Clinical Project Manager	Bachelor's Degree	6-8 years of relevant work experience, including 2+ years of project management related experience	N	E/Mgr	Entry Level	FT	
32	7/11	Management Recruiters Intntl	SAS Manager	Bachelor's Degree	5+ to 7 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT	
33	7/11	Ambion Inc	RNA Isolation Associate, Group Leader	Bachelor's Degree	2+ to 5 Years	N	R/A	Experienced (Non-Manager)	FT/1st(Day)	
34	7/8	Abbott Laboratories	Product Manager-Allograft	B.S. degree in business management, marketing, or engineering. MBA preferred.	3 years experience in medical device industry. Allograft and donor bone industry experience preferred	N	E/Mgr		FT	
35	7/8	PPD Development	Manager,Clinical Data Management	Bachelor's Degree	3 years experience in a professional environment, preferably with clinical or medical data or in a software development environment, and 3 years of data management experience. 1 year supervisory experience	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT/1st(Day)	

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
36	7/8	PPD Development	Sr.Clinical Data Analyst	Bachelor's Degree or equivalent	3 years experience in a professional environment, preferably with clinical or medical data or in a software development environment, and 2 years of clinical data management experience	N	R/A	Experienced (Non-Manager)	FT/1st(Day)	
37	7/8	PPD Development	Associate Director,Clinical Data Management (RADTeam)	Bachelor's Degree	2+ to 5 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT/1st(Day)	
38	7/8	PPD Development	Senior Clinical Data Analyst (Technical Operations)	Bachelor's Degree	2+ to 5 Years	N	R/A	Experienced (Non-Manager)	FT/1st(Day)	
39	7/8	Ambion Inc	Manufacturing Development Associate I	Bachelor's Degree	2+ to 5 Years	N	A/D	Experienced (Non-Manager)	FT/1st(Day)	
40	7/6	Ambion Inc	Quality Assurance Supervisor	Bachelor's Degree	5+ to 7 Years	N	A/D	Manager (Manager/Supervisor of Staff)	FT/1st(Day)	
41	7/5	Etech Hi, Inc.	Director of Clinical Operations	Bachelor's degree in a health science or related field	7+ to 10 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT	65,000 to 90,000 per year

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
42	7/5	Salem Management DBA Rudy Sale	Alliance Sales Manager	Bachelor's Degree	2+ to 5 Years	N	B/M/A	Experienced (Non-Manager)	FT	60,000 to 70,000 per year
43	7/1	Quintiles Transnational	Associate Director of Project Management	Bachelor's degree,	5 years of clinical experience and 4 years of project management experience. 3 years of line management experience and PMP Certification are a plus	N	E/Mgr	Entry Level		
44	6/28	Cubist Pharmaceuticals Inc.	Regional Business Director, Southwest Region	Bachelor's Degree	10+ to 15 Years	N	E/Mgr			
45	6/27	Ambion Inc	Group Leader Oncology-Diagnostics	Doctorate	7+ to 10 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT/1st(Day)	
46	6/27	Ambion Inc	Director/ Manager of Oligonucleotide Services-Diagnostics	Master's Degree	7+ to 10 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT/1st(Day)	
47	6/21	Sanford Rose Associates	Clinical Project Manager	Bachelor's Degree	2+ to 5 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT	70,000 to 85,000 per year
48	6/14	The Bernard Group	Public Relations Executive	Bachelor's Degree	5+ to 7 Years	N	E/Mgr	Executive (SVP, VP, Department Head, etc)Temporary / Contract / Project	FT, PT	75,000 to 150,000 per year

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Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
49	6/8	Ambion Inc	Research Associate-Array Services	Master's Degree	5+ to 7 Years	N	R/A	Experienced (Non-Manager)	FT/1st(Day)	
50	6/7	i3 Pharma Resourcing	SrAssessment Specialist, Cary, NCorBasking Ridge,NJ	Ph.D. qualification or equivalent in psychology/behavioral sciences, or Medical degree with experience in Psychiatry	Experience working in a clinical research organization (CRO) or an investigational site would be advantageous	N	R/A		FT	
51	6/6	Quintiles Transnational	Entry Clinical Research Associate	Bachelor's degree in a health related field	Two years or more of Clinical Research Coordinator experience. Experience with CNS, Oncology or Cardiovascular Trials	N	R/A	Entry Level		
52	6/2	PPD Development	Contract Analyst	Bachelor's Degree	3-5 years' experience in contract drafting and negotiation experience or equivalent combination of education and experience that provides the knowledge, skills, and abilities to perform the job	N	B/M/A		FT	
53	6/2	Clin Force	Associate Director of Clinical Operations	BA/BS Degree	7 years experience in clinical research	N	E/Mgr		FT	

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R= Relevant for WorkSource,P= Possibly relevant, N=Not Relevant
Tech1=LabTechnician,Tech2=CustomerSupportTech,R/A=Researcher/Analyst,A/D=Assembly/Distribution,B/M/A=Business/Marketing/Administration,
E/Mgr=Executive/Manager,O=Others

Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
54	6/1	Company Confidential	Director of Operations	Bachelor's Degree	10+ to 15 Years	N	E/Mgr	Executive (SVP, VP, Department Head, etc)	FT/1st(Day)	
55	6/1	Ambion Inc	EMITeam Lead (QCTeamLead)	Bachelor's Degree	2+ to 5 Years	N	A/D	Experienced (Non-Manager)	FT	
56	5/27	Ambion Inc	Production Manager-Protein	Bachelor's Degree	7+ to 10 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT	
57	5/24	Irwin International Staffing	QA Group Manager*	Bachelor's Degree	5 years in a Quality Assurance Management position and previous experience with FDA/GMP/QSR guidelines and sterile pharmaceutical experience	N	E/Mgr		FT	100,000 to 130,000 per year
58	5/20	Consolidated Technologies	Formulation Chemist I	Bachelor's Degree	2+ to 5 Years	N	R/A	Entry Level	FT/1st(Day)	
59	5/20	ViaGen, Inc.	Sales Representative-GeneticTesting	Bachelor's Degree	2+ to 5 Years	N	B/M/A	Experienced (Non-Manager)	FT	
60	5/20	Ambion Inc	Director of Business Development Diagnostics	Master's Degree	7+ to 10 Years	N	E/Mgr	Manager (Manager/Supervisor of Staff)	FT	
61	5/19	ATMI, Inc.	Analytical Chemist	Bachelor's Degree	2+ to 5 Years	N	R/A	Experienced (Non-Manager)	FT	

*US-TX-Statewide
R= Relevant for WorkSource,P= Possibly relevant, N=Not Relevant
Tech1=LabTechnician,Tech2=CustomerSupportTech,R/A=Researcher/Analyst,A/D=Assembly/Distribution,B/M/A=Business/Marketing/Administration,
E/Mgr=Executive/Manager,O=Others

Appendix B (continued)

	Date	Company	Job Position	Requirement	Experience	Career Level Code	Job Position Classification	Career Level	Job Status /Shift	Salary (USD)
62	5/2	Quintiles Transnational	Associate Director of Project Management	Bachelor's Degree	5 years of clinical experience and 4 years of project management experience. 3 years of line management experience and PMP Certification are a plus.	N	E/Mgr	Entry Level		
63	4/29	Quintiles Transnational	Senior Clinical Project Manager	Bachelor's Degree		N	E/Mgr	Entry Level		

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