Life Science Research and Biotechnology Industry Cluster

Needs Assessment

Abstract:
This needs assessment reports the perceptions and recommendations of 60 employers of Texas life science research, and biotechnology organizations about their:

- Workforce needs
- Workforce essential skills
- Hiring education level
- Primary organizational product or service

The current size and stage of the biotechnology employers is not large, thus limiting the responses. However, extrapolating projected growth rates may result in much larger demand. Regardless, these results lay the foundation of what skill-sets and qualifications the existing employers are seeking.

Introduction

The Texas Healthcare and Biotechnology Institute lists 29 biotechnology sector companies, 3 medical device sector, 5 companies in the non-profit research sector, 16 companies in the pharmaceutical sector, and 22 organizations in the research institution sector[1]. There are not a great number of biotechnology companies, especially those earning revenues from sales and services, yet in Texas. With the size of the academic life sciences research enterprises and other research entities in Texas, it is only a matter of time. Our biotechnology and life sciences industry cluster is gaining momentum in terms of increasing new companies, new venture capital investment and visibility, state support for commercialization expansion and growth, and an improved business culture. Texas continues to make the short list for relocation searches; however we do not seem to be strongly competitive because we have the appearance of not being able to produce an educated and **trained** workforce.

This is a report from the 60 respondents of an employer survey conducted during the summer of 2005 by the College of Technology. Initially, the study was designed to address the employers located in the Houston region, from Galveston to College Station; however, we found it important to expand our area to other major regions of the state to obtain a larger population to report upon. One weakness in this analysis is that we accumulated only results from 60 (39% response) industry cluster employers. The results were processed by writing a Microsoft Access program to capture, and manage the results; data was calculated in a SPSS program to obtain statistical results. Our goal was to quantify what our life science research and biotechnology employers were telling us about the workforce and the skill sets they were looking for in their employees.

There has been an extensive amount of research and discussion leading to various reports pertaining to the coming of the biotechnology industry cluster as exemplified in these sites[2]. From these various

[1] http://www.thbi.org/industry/directory web site of the Texas Healthcare and Biotechnology Institute
[2] http://www.doleta.gov/BRG/Indprof/Biotech.cfm, http://www.thbi.org/econ_dev_reports, http://www.bidc.state.tx.us/Industry%20Reports/Biotech%20Report.pdf, http://www.forrester.com/FocusOnHC, http://www.angeloueconomics.com/news_rep_txbusclimate.html,

reports, and from current experiences by regional economic development organizations, we know that a life science economic cluster requires at least three critical elements to thrive: a) strong academic research activity b) available investment capital c) and a trained and well-developed workforce. Life science related employment in the Houston region is expected to grow significantly over the coming 5-10 years. The questions developed for this survey were compiled by discussions with industry employers, research of what had been asked by Department of Labor grant recipients, and consultation by a survey specialist.

The industry needs skilled employees for academic life sciences research - within the lab and clinical research arenas; and for developing, manufacturing, and selling life-science-derived products, such as small-molecule and biological therapeutics, diagnostics and medical devices. Because in the life sciences research laboratory, the resulting products and their manufacture are complex and often highly regulated, the employees needed for the businesses that sell them require extensive, often lengthy, technically specialized training. Without these highly skilled employees, regional life-science businesses suffer as they attempt to grow. The region is limited in its ability to attract and retain vertically integrated life science companies. This leads to the conclusion that with investments in new technologies must come a simultaneous investment in a pipeline of education and training.

Purpose

The purpose of this study was to gather the perceptions and recommendations of the life sciences research and biotechnology employers within Texas regarding the training and development needs of their workforce. The results collected are being used to assess possible collaborative education and training programs which will benefit the employers' workforce needs of today and in the future. UH College of Technology (COT), Center for Life Sciences Technology (CLiST) is actively engaged in the development of a continuum of education and training programs for the bioscience workforce. As a catalyst in the state's biotechnology workforce development initiatives, CLiST initiated working relationships with a number of key stakeholders, including bioscience research and industry companies, the Workforce Investment Board, Economic Development Organizations and other NPO's, and colleges and universities. The consortium members are actively working to build a vision for results-oriented biotechnology workforce education and training.

Methods

Instrumentation

The survey instrument consisted of 10 primary questions, with refining inquiry in each category (see appendix A). The questions addressed the organizations' industry role, and the education levels of people hired in the technician and technologist positions. After defining the area of focus for the company, the researcher felt that the most important questions dealt with the qualifications most important to the organization, and essential skills being sought. In addition, clarification about the hiring practices of foreign national people was asked. Sample qualification disciplines and techniques, as well as skill levels separated by basic biotechnology, biochemical techniques, laboratory management, advanced biotechnology, and information management were listed for employers to prioritize.

Procedures

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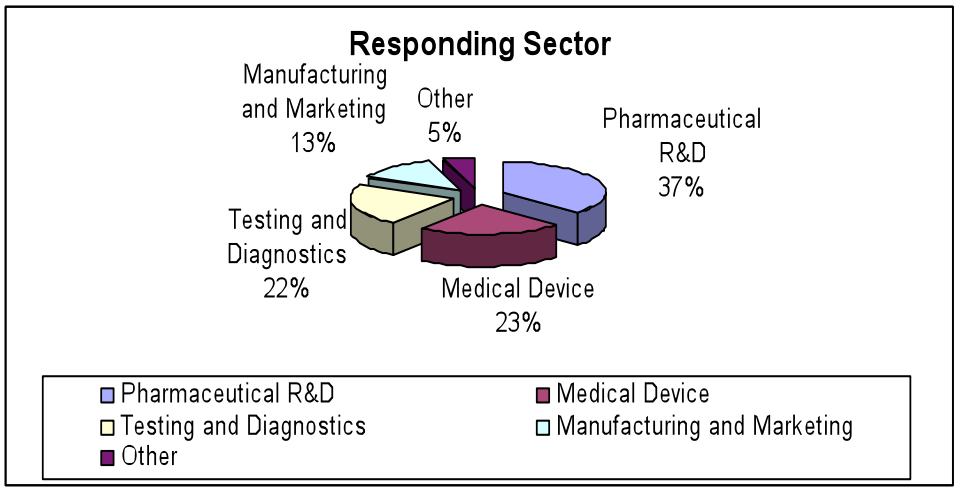
http://www.moneycentral.msn.com/articles/invest/extra/7598.asp.

The participants were identified from published membership lists of the BioHouston, Greater Houston Partnership, The Texas Healthcare and Biotechnology Institute, and other local directories of life sciences research institutions and biotechnology organizations. Surveys were attached to email and distributed at least twice. Recipients were asked to either return the completed survey by email, FAX or by mail. Data was entered into a Microsoft Access data file and transferred into a SPSS package for data analysis.

Sample

Of the 60 respondents the respondents were asked to self select their sectors, the pharmaceutical R&D sector represented the largest responses with 37%, followed by medical devices with 23% of the total, see Chart 1

Chart 1 Survey respondents by sector



The education mix of hired employees into these organizations was reported as follows from low to high:

Certificate	3.0%
MBA	10.0%
Associates of Arts or Sciences	13.0%
Master of Arts or Sciences	21.0%
Doctoral	25.0%
Bachelor of Arts or Sciences	27.0%

Results

Workforce Needs

Taken as a whole, the organizations reported that their highest rated needs and least rated needs were as follows in Table 1:

Table 1

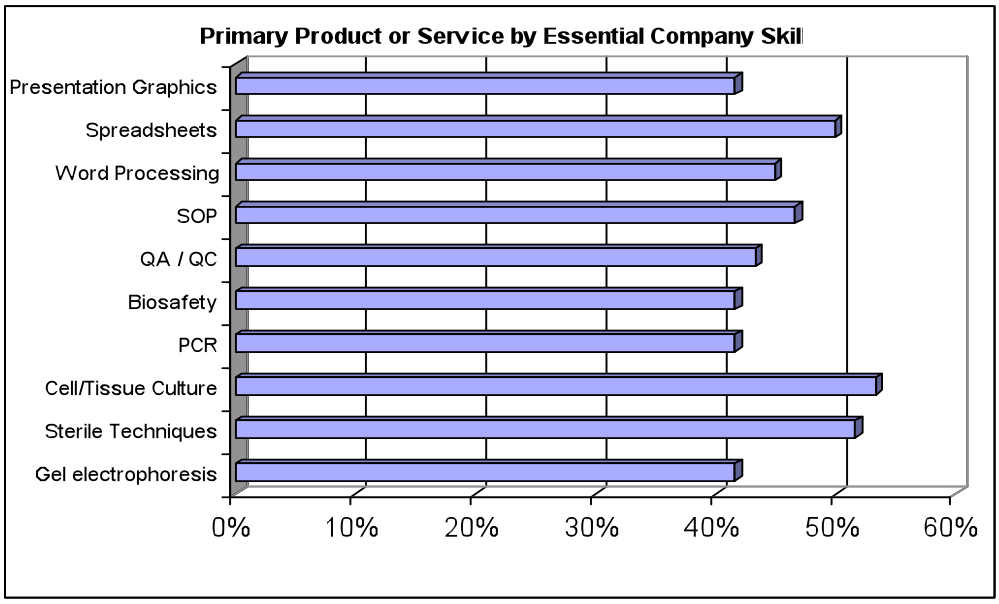
Qualifications Category	**Top Need**	**Top Rank**	**% of Category**	**Least Need**	**Least Rank**	**% of Category**
Discipline	Lab Experience	1	15%	Clinical Chemistry	11	3%
	Molecular Biology	2	13%	Virology	10	4%
	Cell / Tissue Culture	3	12%	Statistics	9	6%
Techniques	General Laboratory	1	18%	Informatics	9	4%
	Lab Notebook Keeping	2	16%	Error Handling	8	6%
	Computer	3	15%	Literature Familiarity	7	6%
Skills Category	**Top Component**	**Top Rank**	**% of Category**	**Least Component**	**Least Rank**	**% of Category**
Basic Biotechnology	Cell Tissue Culture	1	18%	RNA Isolation	7	11%
	Sterile Technique	2	17%	Recombinant DNA	6	12%
	PCR	3	14%	DNA Isolation	5	13%
	Gel Electrophoresis	3	14%			
Biotechnology Techniques	Column Chromatography	1	26%	Protein Sequencing	4	12%
	Protein Purification Analysis	1	26%	HPLC	3	25%
Lab Management	QA/QC	1	12%	ISO 9000	12	4%
	SOP	1	12%	CGCP	11	5%
	Bio Safety	3	11%	Basic Animal Care	10	6%
	Regulatory Issues	3	11%			
Advanced Biotechnology	ELISA	1	9%	Plant Biotechnology	18	1%
	Western Blotting	2	8%	Virology	17	4%
	Immunological Methods	3	7%	Immunoprecipitation	17	4%
Information Management	Spreadsheet	1	20%	Groupware	8	3%
	Word Processing	2	18%	Statistics	7	7%
	Presentation graphics	3	17%	Imaging / Image Analysis	6	11%

Analysis of needed hiring SKILL SETS

When the segments were separated by organizational primary product , the most important skills for the *medical device organizations* were those in the information management section, while the *pharmaceutical R&D* companies said that the basic biotechnology skills were most important, interestingly, *the manufacturing and marketing organizations* emphasized the need singly for QA/QC skills, and testing & diagnostics organizations reported equal skill needs in each of the three skill

categories basic biotechnology, laboratory management, and information management with a variance of five points, represented below in Table 2.

Chart 2 Essential skills for all respondents



Of all respondents, 53% said that Cell / Tissue Culture experience, 52% said that Sterile Techniques and 50% said Spreadsheet technology were essential company skills.

We then examined the essential needed skills by the hiring education levels; we found that among all education levels, there was only a six point variance among the skill categories of basic biotechnology, laboratory skills, and information management. Table 3 demonstrates how the respondents reported their hiring educational levels and desired most essential company skills.

Table 3 Hiring education level and essential company skills

Essential Company Skills		
Basic Biotechnology	Laboratory Mgmt	Information Mgmt

	Gel Electrophoresis	Sterile Techniques	Cell Tissue Culture	PCR	Biosafety	QA / QC	SOP	Word Processing	Spreadsheets	Presentation Graphics
Certificate	16%	13%	13%	16%	20%	19%	21%	19%	17%	16%
Associates of Arts or Sciences	52%	45%	47%	52%	44%	58%	50%	56%	60%	60%
Baccalaureate of Arts or Sciences	96%	94%	94%	92%	96%	100%	89%	93%	97%	96%
Masters of Arts or Sciences	84%	77%	72%	84%	76%	85%	82%	78%	83%	84%
Master of Business Admin	40%	39%	34%	40%	32%	46%	43%	37%	43%	48%
Doctoral	100%	100%	94%	100%	92%	85%	93%	81%	87%	84%

This table suggests that for all responses, the people with certificate training are in greatest need for laboratory management skills including SOP, Biosafety, and then QA/QC; while Associates graduates are in need of Information Management skills including presentation graphics, spreadsheets, and word processing. The most telling from this table demonstrates that the Baccalaureate education level has the highest need for each of the highest ranked ten skill sets, with all being selected at least 89% of the time. This leads to the author's conclusion that the College of Technology should pursue the development of a new variety of new Life Sciences Technology programs that fulfill these needs (certificate, professional certificate, and bachelors program. This was recently validated while the author met with several regional economic development specialists, two academic research laboratories, and an industry relocation specialist.

Analysis of needed hiring QUALIFICATIONS

Chart 3 below is a summarization of all respondents and their expressed most important qualifications of new hires. Note that the three technology categories general laboratory, lab notebook keeping, and computer ranked highest, followed by the disciplines of lab experience.

Chart 3 Most important qualifications across all primary product or service responses

Of all respondents, 60% said that General Laboratory, 55% said that Lab Notebook Keeping, and 52% said Lab Experience were essential company qualifications of new hires.

And when we examined the most important qualifications by the hiring education levels, we found:

Table 5 Most important qualifications by Hiring education level

	Most Important Qualifications						
	Disciplines			Technologies			
	Biochemistry	Molecular Biology	Lab Experience	DNA Technology	General Laboratory	Lab Notebook Keeping	Computer
Certificate	7%	11%	16%	19%	11%	18%	17%
Associates of Arts or Sciences	33%	48%	52%	48%	44%	45%	53%
Baccalaureate of Arts or Sciences	93%	93%	94%	93%	94%	94%	93%
Masters of Arts or Sciences	74%	78%	71%	74%	75%	76%	77%
Master of Business Admin	37%	33%	32%	30%	33%	33%	43%
Doctoral	96%	96%	97%	100%	94%	100%	90%

This table suggests that the College of Technology should pursue its activity of developing a new variety of Life Sciences Technology programs that fulfill these needs (certificate, professional certificate, and bachelors program.

Other interesting facts

The fourth question addressed the numbers of technicians and technologists currently employed. Of those that completed this answer, the results are reported in table 6 below.

Do you employ either life sciences or biotechnology "Technicians or Technologists"?
For this survey, a Technician would include those in positions like Associate Scientist, or Analyst positions supporting the PhD and MD Scientists; while Technologists would include those in positions like Senior Associate Scientist, or Senior Analyst positions supporting the PhD and MD Scientists.

If YES, how many full time equivalents (FTE) "Technicians and Technologists" do you employ in life sciences and biotechnology?

Table 6 Current positions filled

	Technicians	Technologists	Total	Technicians	Technologists	Total
Medical Devices	26	12	38	3%	2%	3%
Pharmaceutical R & D	292	170	462	35%	34%	34%
Manufacturing & Marketing	68	27	95	8%	5%	7%
Testing & Diagnostics	111	40	151	13%	8%	11%
Biofiltration	0	0	0	0%	0%	0%
Other	340	257	597	41%	51%	44%

Total	837	506	1,343	100%	100%	100%

The single largest segment, from the 60 responses, is in the "Other" category, employing almost 600 life science technician and technologist employees, of which technicians are the larger group representing 57% of the total "Other" segment. The "Other" category is made up of organizations describing their organization doing work in: optimization of biotech production; pharma manufacturing & Regulatory / Quality consulting; contract research services; contract research; translational biomedical & biotechnology; pharmaceutical consultants; research; ground and flight medical and research hardware design; development and integration, and there were 11 responses in this category. The Pharmaceutical R & D sector is the next largest employer group with 462 employees, of which 63% are technicians and 37% technologists, according to our definition, within the 21 responses. There were 14 companies who labeled themselves to be Medical Device companies, 9 Manufacturing and Marketing, 13 as Testing and Diagnostics, 0 reporting Biofiltration. Of the 60 responding organizations, 2 did not classify themselves, 49 classified themselves with one Product or Service, and five organizations classified themselves in two Product or Service, while three organizations classified themselves in three Product or Service segments.

The fifth question asked for the number of technicians and technologists that were employed in each firm five years ago, in 2000, the results are displayed in table 7.

(Approximately) how many "Technicians and Technologists" did your organization employ five years ago (in 2000)?

Table 7 Positions in 2000

	Technicians	Technologists	Total	Technicians	Technologists	Total
Medical Devices	7	1	8	2%	0%	1%
Pharmaceutical RD	114	71	185	27%	28%	27%
Manufacturing & Marketing	29	26	55	7%	10%	8%
Testing & Diagnostics	39	14	53	9%	5%	8%
Biofiltration	0	0	0	0%	0%	0%
Other	233	145	378	55%	56%	56%
Total	422	257	679	100%	100%	100%

From this we suggest that the industry cluster has doubled in the past five years, from 679 technician and technologists to 1,343 currently. The growth of the Medical Device sector grew fastest at the rate of 79%, followed by the Testing and Diagnostics sector with a 65% growth, and then the Pharmaceutical R&D sector with 60% growth.

The sixth question asked for clarification about how many technician and technologist positions were being recruited for currently, results are displayed in table 8.

Do you have any vacancies for life sciences or biotechnology "Technicians or Technologists" at this time? If YES, how many full time equivalent (FTE) life sciences and biotechnology Technicians and Technologists are you looking for?

Table 8 Currrent vacancies

	Technicians	Technologists	Total	Technicians	Technologists	Total
Medical Devices	6	4	10	9%	12%	10%
Pharmaceutical RD	28	18	46	43%	53%	46%

Manufacturing & Marketing	11	3	14	17%	9%	14%
Testing & Diagnostics	10	5	15	15%	15%	15%
Biofiltration	0	0	0	0%	0%	0%
Other	10	4	14	15%	12%	14%
Total	65	34	99	100%	100%	100%

By far the busiest recruiting sector is the Pharmaceutical R&D sector, making up 46% of all recruiting activity, while recruiting for Technicians represents 43% of all Technicians being recruited, and the recruitment for Technologists represents 53% of Technologist recruiting. Of the responses, from these 60 organizations, there are approximately 100 Technician and Technologist vacancies, representing a 7% overall vacancy level. The sector with the highest rate of recruitment is the Medical Device sector, although the numbers of positions being recruited are larger among the Pharmaceutical R&D companies.

Discussion and Recommendations

What this analysis tells me is that our efforts to expand articulation agreements with state-wide community colleges to attract students with life science academic backgrounds into a 2+2 program, will balance best in our new baccalaureate life science technology program. New professional development programs in Science, Technology, Engineering, and Mathematics (STEM) fields should be developed collaboratively with faculty from other programs and professionals from industry, for teachers and industry incumbent workers. Promotion of student internship opportunities within the life sciences research and biotechnology industry cluster on the Wagner Peyser sponsored web-portal.

In summary, this analysis suggests to us that there are large opportunities for the College of Technology to pursue a variety of programs that fulfill these needs (certificate, professional certificate, and bachelors concentration to produce technologists for the life science research and biotechnology industry cluster; the second will be to strengthen the collaborative consortium among employers, economic development organizations, and community colleges including establishing articulation agreements and facilitating student internships among the various employers. Certainly much more discussion with among the community is needed.

This needs assessment has taught us that there is not a standard term for the positions supporting the high-end research in our life science research centers, and in the biomanufacturing organizations. Wanting to address the non- "C" (CEO, CFO, CIO, etc.) positions, we started with the generic term of "Technician and Technologist", where a Technician would include those in positions like Associate Scientist, or Analyst positions supporting the Ph.D. and M.D. Scientists; and the Technologists would include those in positions like Senior Associate Scientist, or Senior Analyst positions supporting the Ph.D. and M.D. Scientists but without success in addressing the entire organizational workforce needs. In light of the numerous infrastructure growths, including the States two newest programs to promote new jobs in the industry cluster, the Enterprise Fund and the Emerging Technology Fund[3]; increase in Venture Capital investments; and the continued increase in academic peer reviewed life science research. The biotechnology/life science industry in the Houston region is growing, as momentum gathers in commercializing the extraordinary life-science technologies that have their origins in the Texas Medical Center and the region's academic and other research institutions. Within the region,

[3] http://www.governor.state.tx.us/divisions/press/initiatives/sots/enterprise, http://www.governor.state.tx.us/divisions/ecodev/etf/

- $1.7 billion in annual research investment is made in the Houston region, ranking the state 3rd nationally in 2003; this research spending has increased 38% since 1999. [4]
- Houston is home to the Texas Medical Center, the largest concentration of universities, biomedical research facilities, and health care institutions in the world; there is tremendous research infrastructure.
- The region boasts international leadership in life-science disciplines including biodefense and infectious disease, bioinformatics, health care informatics, cardiovascular medicine, genomics, metabolic disease, oncology, and bio-nanotechnology.

There is an upward trend in technology commercialization. In the past five years, in the Houston region there have been:

- More than 2,500 invention disclosures.
- More than 2,000 patent applications.
- More than 780 license agreements.
- On average, nearly 20 new start ups annually.

Within the State, the Houston region is the top center for biotechnology research and development, and its institutions and other cluster participants increasingly work in concert:

- Nearly 70% of all life-science research in the state of Texas occurs in the Houston region, as does the majority of life science commercialization activity.
- Houston is home to over 60 life science companies, 12 public companies, and 4 NASDAQ Biotechnology Index companies, and the two largest IPO's in biotech history.
- Houston has a proven record of accomplishment of private/public and public/public consortiums and alliances, such as the Gulf Coast Consortium, the Alliance for NanoHealth, NASA/JSC-University programs, and recent collaborating with GE Healthcare in the UT Research Park, new developments at UTMB with their level four national laboratory and their infectious diseases center.

Advice from employers

Generally, the employers commented that they are extremely busy and overburdened to complete surveys and interviews. There seems to be an increasing curiosity about this industry cluster and what they will need in terms of trained workforce characteristics for which the employers have limited resources and time to be involved. We acknowledge the employers' limitations on time and resources for such inquiry and have suggested that our initiative function as the central catalyst for these discussions along with our regional Work Source Board, on behalf of our collaboration partners. Recently, the Texas Governor's Office awarded a Wagner Peyser grant to the UH College of Technology, Center for Life Sciences Technology to continue this research. Our next step will be to examine the methodologies which might be better used in determining the spot market industry workforce demands in order to maximize benefit for employers and the educational systems.

The Center for Life Sciences has been approved by the UH Administration to serve the College of Technology by developing and maintaining a consortium of industry employers, economic development organizations, workforce entities, and education institutions, including independent school districts, colleges, and universities. In addition, the Center is establishing an industry web-portal www.bio.tech.uh.edu for the purposes of sharing life sciences technology workforce and education information, including curriculums, lab materials, and assessment tools for use by the consortium

[4] BioHouston 2005 Industry Census

membership. Our next step, supported by a Wagner Peyser Grant, will be to conduct a new assessment of the biotech/life science industry cluster workforce supply and demand methodologies, identifying: possible approaches to industry skills assessments in highly dynamic labor markets such as biotech; design and pilot test new approaches to identifying industry skills requirements in rapidly changing industries; and suggest ideas for further research.

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4 BioHouston 2005 Industry Census,
Association of University Technology Managers (2003 data)

Appendix A Survey Questionnaire

Houston Life Sciences & Biotechnology Workforce Initiative

Employer Survey

The Life Sciences and Biotechnology Workforce Initiative is a collaborative project to insure that Houston life sciences and biotechnology firms and research laboratories can draw from a well-qualified workforce in the future. The Initiative is sponsored by the Technology Workforce Consortium, a 21-county collaboration of colleges and universities with biotechnology programs, biotechnology companies, life science research universities, and interested non-profit organizations such as economic development partnerships, BioHouston, and the Texas Medical Center. Members of the Consortium have asked the College of Technology at the University of Houston to take the lead on coordinating Consortium activities, the first of which is this survey.

The survey is designed to measure the current and future demand for life sciences and biotechnology technicians and technologists in the Houston region. The educational institutions who prepare students for these positions need these data for their own planning. The Consortium is also considering applying for workforce and training grants should this survey show a deficit of current and projected future qualified candidates for these positions.

The survey is only 10 questions which we hope should take no more than 15 to 20 minutes, depending on how available your employment data happen to be. We hope you can spare that time to be sure we have an adequate life sciences and biotechnology workforce in Houston.

Should you have any questions, please contact Christopher Baca, University of Houston, College of Technology, at (713) 743-4076, or CLBaca@UH.edu.

Thank you.

Use the tab key to move to the next question.

1. Is your organization engaged in Life Sciences Research and/or Biotechnology?

Yes ☐ No ☐

If you answered NO, then you probably do not need to respond to this survey. Please fill out the information at the end of the survey.

If you answered YES, please continue.

2. What is your primary product or service?

Product or Service	
Medical Devices	☐
Pharmaceutical R&D	☐
Manufacturing and Marketing	☐
Testing and Diagnostics	☐
Biofiltration	☐
Other (Write In)	
[Type Other Here]	☐
[Type Other Here]	☐

3. What educational levels do your employees have when they are hired?

Certificate	☐
Associate of Arts or Sciences	☐
Bachelor of Arts or Sciences	☐
Master of Arts or Sciences	☐
Master of Business Administration	☐
Doctoral (Ph.D. or M.D.)	☐
[Type Other Here]	☐

4. Do you employ either life sciences or biotechnology "Technicians or Technologists"?

For this survey, a Technician would include those in positions like Associate Scientist, or Analyst positions supporting the PhD and MD Scientists; while Technologists would include those in positions like Senior Associate Scientist, or Senior Analyst positions supporting the PhD and MD Scientists.

Yes ☐ No ☐

If you answered NO, skip to question 6.

a. If YES, how many full time equivalents (FTE) "Technicians and Technologists" do you employ in life sciences and biotechnology?

FTE Technicians: 0 FTE Technologists: 0

b. Of the FTE listed above, how many of the "Technicians and Technologists" are American citizens and how many are Foreign Nationals?

	American citizens	Foreign nationals
Technicians	0	0
Technologists	0	0

5. (Approximately) how many "Technicians and Technologists" did your organization employ five years ago (in 2000)?

FTE Technicians: 0 FTE Technologists: 0

6. Do you have any vacancies for life sciences or biotechnology "Technicians or Technologists" at this time?

Yes ☐ No ☐

If you answered NO, skip to question 8.

a. If YES, how many full time equivalent (FTE) life sciences and biotechnology Technicians and Technologists are you looking for?

FTE Technicians: 0 FTE Technologists: 0

7. We would like to see the job postings for the technician and technologist positions you currently are seeking to fill.

a. If these are available on the Internet, what is the URL?
[Type Address Here] *
**If these are not available on the Internet please attach the job postings to this survey.*

8. Traditionally, how difficult has it been to find qualified applicants for "TECHNOLOLGIST" positions? *(Use the drop down menu below to select the appropriate answer)*

- Select One -

a. If you answered SOMEWHAT OR VERY DIFFICULT, are you receiving enough applicants for these "technologist" positions? *(Use the drop down menu below to select the appropriate answer)*

- Select One -

b. If you answered SOMEWHAT OR VERY DIFFICULT, are the majority of applicants you received qualified for these "technologist" positions? *(Use the drop down menu below to select the appropriate answer)*

- Select One -

c. If you were to hire a "Technician or Technologists" today, what qualifications would be most important for your organization?

Disciplines		Techniques	
Microbiology	☐	DNA Technology	☐
Biochemistry	☐	General Laboratory	☐
Clinical Chemistry	☐	Informatics	☐
Chemistry	☐	Error Handling	☐
Molecular Biology	☐	Lab Notebook Keeping	☐
Genetics	☐	Literature Familiarity	☐
Others (Write In)		Computer	☐
Cell/Tissue Culture	☐	Research Integrity	☐
Lab Experience	☐	Presentation Skills	☐
Virology	☐	Others (Write In)	
Statistics	☐	Work Independently	☐
Biology	☐	SDS PAGE and protein purification	☐
[Type Other Here]	☐	Production Skills	☐
[Type Other Here]	☐	GMP	☐
[Type Other Here]	☐	Animal Handling	☐
[Type Other Here]	☐	Tissue Culture/Virology	☐
[Type Other Here]	☐	[Type Other Here]	☐
		[Type Other Here]	☐
		[Type Other Here]	☐
		[Type Other Here]	☐

e. Approximately how many months does it take you to hire a qualified "TECHNOLOGIST" in life sciences and biotechnology?

0 Months

Not Applicable ☐

Which of the following skills are essential to your organization?

None/ Not Applicable ☐

Basic Biotechnology		**Advanced Biotechnology**	
Recombinant DNA	☐	*In Vitro* Transcription	☐
DNA isolation	☐	*In Vitro* Translation	☐
RNA isolation	☐	*In Vitro* Mutagenesis	☐
Gel Electrophoresis	☐	Hybridoma Techniques	☐
Sterile Technique	☐	Antibody Production	☐
Cell/Tissue Culture	☐	ELISA	☐
PCR	☐	Immunoprecipitation	☐
Other (Write In)		Plant Biotechnology	☐
[Type Other Here]	☐	DNA Sequencing	☐
[Type Other Here]	☐	*In Situ* Hybridization	☐
[Type Other Here]	☐	DNA Synthesis	☐
Biochemical Techniques	☐	Southern Blotting	☐
Column Chromatography	☐	Other (Write In)	
HPLC	☐	Northern Blotting	☐
Protein Purification/Analysis	☐	Western Blotting	☐
Other (Write In)		Immunological Methods	☐
[Type Other Here]	☐	Virology	☐
[Type Other Here]	☐	Histology	☐
[Type Other Here]	☐	Flow Cytometry	☐
Laboratory Management	☐	[Type Other Here]	☐
CGLP	☐	[Type Other Here]	☐
CGMP	☐	[Type Other Here]	☐
CGCP	☐	[Type Other Here]	☐
Biosafety	☐	[Type Other Here]	☐
QA/QC	☐	**Information Management**	
Basic Animal Care	☐		
SOP, (standard operating procedures)	☐	Bioinformatics	☐
Instrument Validation	☐	Word Processing	☐
Other (Write In)		Database	☐
Laboratory Management	☐	Spreadsheet	☐
Regulatory Issues	☐	Presentation graphics	☐
ISO 9001	☐	Groupware	☐
Radioactive Isotopes	☐	Imaging/Image Analysis	☐
[Type Other Here]	☐	Other (Write In)	
[Type Other Here]	☐	Statistics	☐
[Type Other Here]	☐	[Type Other Here]	☐
		[Type Other Here]	☐

10. Do you have plans to increase your "Technician and/or Technologist" positions over the next few years?

Yes ☐ No ☐

a. If YES, approximately how many "Technician and Technologist" positions do you expect to ADD in the following years?

	In 2006	In 2007 and 2008	In 2009 and 2010
Technicians	0	0	0
Technologists	0	0	0

Any data we collect will be reported in a summary format only. Yet we would like your contact information in case we have questions regarding your responses.

Person completing survey: [Type Name Here]

Position: [Type Position Here] Organization: [Type Organization Here]

Zip Code: [Type Zip Code Here] Phone #: [Type Phone # Here]

E-Mail address: [Type E-Mail Address Here]

Comments: [Enter Comments Here]

If returning this survey by mail, please return to:
Christopher Baca, University of Houston, College of Technology, 300 Technology Building
Houston, TX 77204-4021. Or if by FAX: 713-743-5699.

Thank you very much for your time. We trust that this information will help us strengthen the life sciences and biotechnology workforce in the Houston region. If you have any more questions, please contact Chris Baca at (713) 743-4076 or CLBaca@UH.edu.