

An Evaluation of the Earnings and Workforce Development Impacts of the BioTechnical Institute of Maryland, Inc.



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Executive Summary

The BioTechnical Institute of Maryland (BTI) is a successful and important job training program that places its graduates in jobs in a vital and growing sector of the City, region, and State economy. BTI graduates experience gains in employment and earnings that meet or exceed the experience of other workforce training programs. The BTI program provides a source of workers in an industry in which there is a significant gap in training programs and is highly regarded by its clients.

The Jacob France Institute conducted an occupational needs analysis, client perception survey, and earnings and employment evaluation of the BTI program. Some of the major findings of this analysis are as follows:

- **BTI's training programs are successful.** Eighty-five percent of BTI graduates were employed at some time in 2005 and had average earnings of nearly \$18,975. On average, each BTI class experienced a 22% increase in employment participation and \$1,300 increase in quarterly earnings after the training is completed.
- **The occupations for which BTI trains workers are in demand.** The Maryland Department of Labor, Licensing and Regulation estimated that there will be 583 openings for biotechnology-related technical workers per year through 2014.
- **The workers for these occupations are in short supply.** The JFI analysis identified only 56 community college degrees awarded by related programs in 2005, and many of these graduates go on to complete a four year degree. Thus, Maryland is facing a shortage of trained and skilled workers in these positions. The businesses interviewed reported difficulties in finding skilled technicians.
- **BTI is considered to be a good source of technical workers.** The businesses interviewed regarded BTI as providing a needed service and a key component of State, regional and City efforts to meet the workforce needs of the biotechnology sector.

Based on this analysis, the Jacob France Institute concludes that given the need for BTI graduates and its demonstrated track record of success in both its placement of graduates in jobs and the earnings gains experienced by its graduates, BTI's programs should be expanded. BTI should explore expanding its services into new areas, such as Frederick County, that are experiencing biotechnology employment growth, or Prince George's County, where there is an existing base of biotechnology companies and a potential training population similar to its current profile. BTI should also expand its Baltimore training capacity to meet the demands created by the development of two university biotechnology research parks. Finally, BTI should pursue a relationship with the Maryland Department of Business and Economic Development (DBED) to become a vendor or specialized employer-based training services provider that can be brought in to provide training to targeted biosciences employers under MITP or PWQ.

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1.0 Introduction and Summary of Results

The BioTechnical Institute of Maryland (BTI) retained the Jacob France Institute of the University of Baltimore to conduct an analysis of the overall importance of its training programs and to develop a series of strategic options for new training initiatives that BTI can implement. The JFI conducted the following research steps:

- Interviewed key informants in biotechnology companies, in the foundation community and in the workforce and economic development field who are knowledgeable about the biotechnology sector and its workforce development needs;
- Analyzed the employment status and earnings of all of BTI's graduates from 1997 to 2005; and
- Developed, based on the interviews and a limited search of readily available literature, high level recommendations for BTI to explore in order to achieve its long- term goals and potential.

Some of the key findings of this analysis are as follows:

- The biotechnology sector is a critical, dynamic and growing part of both the Baltimore region and Maryland's economy. The lack of available workers, from the entry-level to those with advanced degrees, is a key constraint on the sectors current and expected growth.
- The key informants in the biotechnology sector interviewed for this project have a strongly positive view of BTI and its graduates.
- BTI training programs were seen as providing a needed service and were viewed as a key component of State, regional and City efforts to meet the workforce needs of the biotechnology sector.
- Eighty percent (80%) of BTI training program graduates are employed in the first full quarter immediately following the completion of their training. Nearly three-quarters of all BTI graduates (74%) were employed in the fourth quarter of 2005, including 86% of the first cohort that graduated in 1998.
- The average BTI graduate experiences an increase of \$6,661 in the year after completing training.
- Most BTI graduates earn well above the poverty level; the average 2005 earnings for all BTI graduates was just under \$25,000, with the early cohorts of graduates earning around \$30,000 on average.
- BTI graduates are placed in jobs with earnings growth potential and are eligible for 6 credits toward an AAS degree in Biotechnology from BCCC.
- Given the need for BTI graduates and its demonstrated track record of success in both its placement of graduates in jobs and the earnings gains experienced by its graduates, BTIs programs should be expanded. BTI should explore expanding its services into new areas, such as Frederick County, that are experiencing biotechnology employment growth. BTI should also expand its Baltimore training capacity to meet the demands created by the development of two university biotechnology research parks.

Maryland is ranked fourth nationally in terms of its concentration of biotechnology companies by Ernst & Young in its annual bioscience report.² Maryland ranks second in per capita federal research and development spending (over \$7 billion total) and has a total statewide biotechnology infrastructure investment of over \$450 million. While Maryland's biotechnology sector is centered in the Washington Suburbs of Maryland (Montgomery, Prince George's and Frederick counties); the Baltimore region, which is home to BTI, is an emerging and growing biotechnology center, especially with the ongoing development of the University of Maryland Baltimore BioPark and the Science and Technology Park at Johns Hopkins.

Maryland possesses all of the key drivers to support the growth and development of the biotechnology sector. Overall, Maryland is considered to be a leader in high technology, with the Milken Institute ranking Maryland 4th nationally in its State Technology and Science Index.³ High technology and biotechnology development are based on three core drivers:

Money – The amount of venture capital to support technology development;

Ideas – The development of new technologies to commercialize through research and development; and

Talent – The workforce needed to support high technology development.

Maryland is well positioned in each of these key drivers. In the area of money, the Milken Institute ranks Maryland 5th nationally in terms of its venture capital infrastructure. In the area of ideas, Maryland is ranked sixth nationally in research and development expenditures per capita, and ranked second nationally in federally performed and academic research per capita. In the area of talent, Maryland's workforce is its most important economic development asset. According to the National Science Foundation, Maryland has the 3rd highest level of workers with a Bachelors' degree or above, the 3rd highest concentration of scientists and engineers in the workforce, the highest concentration of science and engineering Ph.D.s in the workforce, and the 2nd highest concentration of life and physical scientists in the workforce in 2004.

3.0 Labor Market Analysis – The Need for Entry-Level Biotechnology Workers

Biotechnology is one of the key sectors targeted for Maryland's ongoing economic development efforts and likely to continue to be a critical growth sector for the State's economic future. As described above, Maryland is well positioned in all of the key drivers to support high technology and biotechnology growth and development, especially in the area of workforce development. This is important because according to *Site Selection* magazine, workforce availability has become the most important factor in biotechnology development with 50% of firms in the Biotechnology and Pharmaceuticals sector citing the availability of skilled workers as the key factor in their corporate location decision.⁴ Maryland's workforce development strengths are concentrated in its high quality colleges and universities. While jobs requiring a bachelor's degree or above are critical in the biotechnology sector, research conducted by the JFI has found that 38% of biotechnology sector jobs are open to persons with less than an Associate's degree, presuming they have received adequate training.⁵

² http://www.ey.com/global/content.nsf/International/Biotechnology_Report_2006_Beyond_Borders

³ http://www.milkeninstitute.org/pdf/state_tech_sci_index04.pdf

⁴ Site Selection Magazine, "Bio-Critical Mass," January 2003, pp. 34-45.

⁵ Unpublished 2006 report on the workforce impact of the UMB Research Park prepared for the Wexford Group.

The BioTechnical Institute of Maryland plays a critical role in providing workers for these entry-level jobs. With Maryland already benefiting from strong university life sciences programs, expanding our supply of entry-level technical workers can become a critical differentiating factor in Maryland’s attractiveness to recruiting, retaining, and developing biotechnology companies. Data from the Maryland Department of Labor Licensing and Regulation are published on occupational employment and openings.⁶ The JFI identified four occupations relevant to the BTI’s training mission. These were: Biological Technicians; Life, Physical, and Social Science Technicians, All Other; Medical and Clinical Laboratory Technicians; and Medical and Clinical Laboratory Technologists. Each of these occupations is described in more detail in Appendix A. As presented in Table 2, based on 2004 projections, there are expected to be 583 annual openings for biotechnology-related technical positions for the 2004 through 2014 period.

Table 2
Key Biotechnology Related Technician Occupations
Employment and Estimated Annual Openings

Occupation	Employment 2004	Projected Employment 2014	Total Projected Openings ¹ 2004-2014	Projected Annual Openings ¹ 2004-2014
Total	<u>14,310</u>	<u>16,715</u>	<u>5,825</u>	<u>583</u>
Biological Technicians	2,885	3,370	970	97
Life, Physical, and Social Science Technicians, All Other	4,250	4,840	1,590	159
Medical and Clinical Laboratory Technicians	3,580	4,180	1,700	170
Medical and Clinical Laboratory Technologists	3,595	4,325	1,565	157

(1) Total and Annual Openings include occupational demand for both replacement and growth

Source: DLLR

As presented in Table 3, the Baltimore Metropolitan Area⁷ is expected to have 225 annual openings – based on earlier projections made for the 2002 through 2012 period.⁸ Because these estimates are based on conditions in 2002, they do not take into account the planned development of the two university-based research parks in Baltimore or the recent state-wide growth in the sector. As a result, these estimates are likely to be quite conservative and probably significantly under-estimate future occupational demand. The Jacob France Institute estimates that the development of the two university biotechnology parks in Baltimore City will increase the projected number of biotechnology technician openings in the City by one-third. This will create an additional 40 biotechnology technician positions per year in the City. No programs have been put in place to provide these needed workers.

⁶ <http://www.dllr.state.md.us/lmi/iandoproj/> -- These data are based on conditions in the year 2004, and projections for the 2004 to 2014 period but were the only data currently available.

⁷ This figure includes Cecil County, which along with Harford County, comprises the Susquehanna Workforce Investment Area.

⁸ The 2004-2014 projections are not yet available at the regional level.

Table 3
Key Biotechnology Related Technician Occupations
Employment and Estimated Annual Openings, By Workforce Investment Area

Item	Occupation	Anne Arundel	Baltimore City	Baltimore County	Frederick County	Lower Shore	Mid-Maryland	Montgomery County	P. G. County	Southern Maryland	Sus-quehanna	Upper Shore	Western Maryland
Employment 2002		<u>435</u>	<u>3,450</u>	<u>1,280</u>	<u>505</u>	<u>225</u>	<u>270</u>	<u>4,655</u>	<u>1,405</u>	<u>140</u>	<u>495</u>	<u>75</u>	<u>315</u>
	Biological Technicians	35	660	40	150	x	25	785	355	x	135	x	x
	Life, Physical, and Social Science Technicians, All Other	70	335	265	105	75	x	2,640	695	20	120	x	70
	Medical and Clinical Laboratory Technicians	220	1,135	465	210	85	185	685	215	65	110	25	145
	Medical and Clinical Laboratory Technologists	110	1,320	510	40	65	60	545	140	55	130	50	100
Projected Employment 2012		<u>530</u>	<u>3,805</u>	<u>1,645</u>	<u>600</u>	<u>310</u>	<u>340</u>	<u>5,110</u>	<u>1,540</u>	<u>170</u>	<u>625</u>	<u>100</u>	<u>410</u>
	Biological Technicians	40	795	60	170	x	25	870	375	x	180	x	x
	Life, Physical, and Social Science Technicians, All Other	75	355	315	120	80	x	2,790	780	20	125	x	85
	Medical and Clinical Laboratory Technicians	275	1,185	590	265	130	240	825	240	75	150	35	190
	Medical and Clinical Laboratory Technologists	140	1,470	680	45	100	75	625	145	75	170	65	135
Total Projected Openings¹ 2002-2012		<u>205</u>	<u>1,205</u>	<u>690</u>	<u>215</u>	<u>140</u>	<u>135</u>	<u>1,535</u>	<u>455</u>	<u>65</u>	<u>250</u>	<u>40</u>	<u>175</u>
	Biological Technicians	10	245	25	45	x	5	215	85	x	70	x	x
	Life, Physical, and Social Science Technicians, All Other	25	100	110	40	20	x	770	245	5	35	x	30
	Medical and Clinical Laboratory Technicians	115	355	250	110	65	100	325	85	30	70	15	85
	Medical and Clinical Laboratory Technologists	55	505	305	20	55	30	225	40	30	75	25	60
Annual Projected Openings¹ 2002-2012		<u>21</u>	<u>121</u>	<u>69</u>	<u>22</u>	<u>14</u>	<u>14</u>	<u>154</u>	<u>46</u>	<u>7</u>	<u>25</u>	<u>4</u>	<u>18</u>
	Biological Technicians	1	25	3	5	x	1	22	9	x	7	x	x
	Life, Physical, and Social Science Technicians, All Other	3	10	11	4	2	x	77	25	1	4	x	3
	Medical and Clinical Laboratory Technicians	12	36	25	11	7	10	33	9	3	7	2	9
	Medical and Clinical Laboratory Technologists	6	51	31	2	6	3	23	4	3	8	3	6

(1) Total and Annual Openings include occupational demand for both replacement and growth

Note: Totals may not sum due to rounding, does not sum to Maryland total due to disclosures and rounding.

Source: DLLR

The State and region are already experiencing worker shortages in key technology-related fields. According to the JFI's *Maryland Business Climate Survey*, 20% of Maryland businesses are experiencing workforce shortages, with 11% of these firms having difficulty finding laboratory and technical personal.⁹ As described below, in the interviews of biotechnology sector key informants, biotechnology businesses are reporting having difficulty finding workers at all skill levels for the technical positions that are served by BTI training and for higher educational and training level positions, where recruitment is from University programs.

Maryland is facing a shortage of trained entry level biotechnology technicians and other workers. The JFI conducted interviews with the seven Maryland community colleges that currently train or plan to train entry-level biotechnology workers. A description of these programs is included as Appendix B. According to the Maryland Higher Education Commission, these programs granted a total of 56 degrees and certificates in 2005. These degrees and certificates account for less than 10% of predicted annual occupational demand (from Table 2), and many of the Associate's degree recipients are likely to go on to complete a four year degree program. While many of the biotechnology technician occupations are undoubtedly filled by a combination of community college and four-year college and university graduates, it is evident from these figures that Maryland is facing a shortfall in supplying the number of biotechnology technicians needed by this critical sector.

Table 4
Community College Degrees Awarded in Potential
Biotechnology Technician Programs, 2005

College/Program	Degree	Degrees Awarded
Allegany College of Maryland		
Medical Laboratory Technician	Lower Division Certificate	2
Medical Laboratory Technician	Associate	8
Baltimore City Community College		
Biotechnology	Associate	8
College of Southern Maryland		
Biotechnology	Lower Division Certificate	0
Biotechnology	Associate	6
Howard Community College		
Biomedical Engineering	Lower Division Certificate	3
Biomedical Engineering	Associate	4
Montgomery College		
Biotechnology	Lower Division Certificate	11
Biotechnology	Associate	14
Total Community College Certificates and Associate Degrees Awarded		56

Source: Maryland Higher Education Commission

⁹ http://www.ubalt.edu/jfi/jfi/mbrp_bcs/BCS3rdqtr06.pdf

4.0 Interview Results

The JFI conducted interviews with key industry informants as a means of collecting information on the importance, impact and potential future role of the BTI. These interviews examined the workforce issues and problems that biotechnology firms are facing and the role of BTI in meeting the needs of Maryland's strong existing base of biotechnology companies and institutions. The main topics discussed with these key informants included: workforce problems; barriers to employment faced by Baltimore City residents; and the opportunities created by the development of the Biotech Parks in Baltimore City. The key informants interviewed were also asked to make recommendations as to how BTI can improve their programs to better serve the biotechnology community in Maryland and Baltimore City.

The JFI conducted 23 interviews. The JFI conducted:

- 10 interviews with key biotechnology firms, related institutions and technical worker placement firms in Maryland; and
- 13 interviews with local foundations, educational institutions, workforce development organizations, and technology advocacy groups.

A list of the persons interviewed for this study is included in Table 5. The results of these interviews are as follows.

Table 5
BioTechnical Institute of Maryland Interviewees

Name	Organization
Dr. Alan Scott	Johns Hopkins University School of Medicine
Bob Eaton	MdBio
Bob Seurkamp	Governor's Workforce Investment Board
Carly Snoops	Lab Support
Charles Bramlett	BioAnalytical Systems, Inc.
Cheryl Williams	East Baltimore Development, Inc.
Dan Dryden	Invitro Technologies
Dave Iannucci	Baltimore County Department of Business Development
Dr. Alex Sulvelidze	Intralytix
Dr. Laundette Jones	University of Maryland Baltimore
Dr. Vicki Wolff-Long	Chesapeake Biological Laboratories
Ed Nolan	Fort Detrick
Gary Coleman	University of Maryland Biotechnology Institute
James Wang	TrimGen
Karen Sitnick	Mayor's Office of Employment Development
LaKeeta Campbell	Kelly Scientific
Lisa Burnworth	Shire Pharmaceuticals
Liz Pettingill	Greater Baltimore Committee
Melanie Styles	Abell Foundation
Patrice Cromwell	Annie E. Casey Foundation
Rene Winsky	Maryland Technology Development Corporation
Sara Trenergy	Baltimore County Department of Business Development
Tim Arbruster	Goldseker Foundation

4.1 The Biotechnology Industry in Maryland

The interviewees expressed the opinion that biotechnology in Maryland will not only continue to grow, but that the industry will become an even larger portion of Maryland's future economic growth, based on regional and national trends in the sector. Opinions differed as to the level of growth that the industry will experience in the next five to 10 years. While all key informants viewed the biotech sector as likely to continue to grow, many viewed biotech as becoming "a major economic force" in the future development of the State.

Interviewees believed several factors would shape the level of biotech growth in the State. One of these factors is the amount of funding made available to biotechnology companies and academic researchers. Key informants noted the amount of funding committed to academic research, from both the State of Maryland, private companies, and, from the federal government, most importantly through the National Institute of Health (NIH), as key influences on the overall growth of the industry in Maryland. Another factor that would determine the overall growth of

the State's biotech industry is the ability of the existing base biotech companies in the State to grow and expand. As these companies prosper, they will create a critical mass that would both attract more biotech firms to the State and promote the development of new entrepreneurial start-ups. Moving forward, while most interviewees reported that the Washington suburbs will continue to be the dominant biotech region in the State, the expected growth in the Baltimore area will change the geographic concentration of the sector. Based on the development of the two proposed university research parks in Baltimore City and the targeted development of biotechnology in Baltimore County, the Baltimore region is expected to become more important location for biotechnology business activity. The availability of workers, at both the technician and more advanced degree levels, will be a critical influence on biotechnology growth in the region and across the state.

Several persons even expressed the belief that the Baltimore has the potential to become the dominant region for biotech in the State in the long term. This belief was based on transformational impact of the development of the Johns Hopkins and University of Maryland, Baltimore biotechnology parks on the region's biotech base. Biotechnology development in the region will benefit from the presence of two leading national research universities, UMB and Johns Hopkins. The academic research conducted at these two universities and their technology parks will spur the development of new companies and new technologies that will further the development of the entire sector. Another reason that interviewees believe the Baltimore region will experience strong biotech growth is the availability of space in the region. Interviewees commented that the Washington region is becoming built out and that the Baltimore region is a place that can accommodate both the attraction and growth of new firms. The region is also seen as benefiting from the lower real estate costs and lower costs of living that can be found in the Baltimore area as compared to Montgomery County. Finally, a few interviewees believed that the improvement of conditions in Baltimore City make the region more attractive to biotech firms that have in the past decided to not locate in the region.

Other key informants, however, were more skeptical about the prospects of biotechnology in the Baltimore region. While the key informants interviewed believe that the two new biotech parks will create positive opportunities for biotech growth, they expressed the belief that the region will be unable to provide the skilled workforce needed to support growth. Another limiting factor was considered to be the lack of a mass transit linkage to the Washington suburbs within the region that will negatively impact the ability of biotech firms to grow and develop in the Baltimore area. Finally, several interviewees believed that the growth of biotech in the Washington suburbs will spill out into other areas of the State before it reaches the Baltimore area, as is already occurring in Frederick County. One key informant highlighted the growth of Frederick County and expressed the belief that future biotechnology industry growth will move north and west out of Montgomery County before growing in the Baltimore region. Despite the different views as to the level of biotech growth in the Baltimore area, interviewees agreed that the opportunities created by the new biotechnology parks would be the largest factor to determining the future of the biotechnology sector in the Baltimore region.

The key informants were asked their opinion on the critical biotechnology sectors likely to drive the growth of the industry in Maryland in the near to long term. The key informants reported that vaccine development, pharmaceuticals, biotech manufacturing, basic biotech research and development, genetics, stem cell research, and gene therapy are the key biotechnology areas likely to grow over the next five to 10 years. One key informant believed

that the concentration of federal laboratories and defense facilities in the state will create opportunities for research, development and commercialization activities in the area of bio-terrorism applications. While some of the key informants questioned the ability of the State or region's economic development policies to directly influence biotechnology industry development, all viewed workforce supply as a critical factor shaping the growth and development of the sector. All key informants reported that the BTI program can serve as a provider of needed entry-level technicians for the biotechnology sector.

4.2 Biotechnology Workforce Issues

There was general consensus among the key informants that the biotechnology sector will continue to grow both statewide and in the Baltimore region. This growth will not only be impacted by the market factors that key informants described above, but also through the ability of biotech firms to attract and retain a skilled workforce. Without a highly skilled and educated workforce, biotech firms are limited in their ability to expand their operations, develop and produce products, and conduct research. The key informants cited several workforce problems that may impact the growth of the biotech industry in Maryland. This section of the report describes these problems, why they are occurring, and provides ways that these problems may be addressed.

There are several workforce problems that are currently impacting biotechnology firms in Maryland which may negatively impact the future growth and development of the sector. These problems include worker shortages, worker retention, and employee turnover.

4.2.1 Workforce Shortages

The key informants reported experiencing workforce shortages across skill levels and positions. Interviewees noted that there is a shortage of business managers of technology companies and other specific highly skilled technical positions. These persons typically are recruited nationally and often are hesitant to locate to Maryland. According to interviewees, the perception exists that there is not a critical mass of biotech firms in Maryland and that if a person leaves one firm, they do not have other potential opportunities for biotech employment in the State. A way to address this issue is to better market the employment opportunities and biotech firms that are located in the State.

Key informants also reported experiencing shortages for lower-skilled and entry-level employees. This shortage may be tied to numerous factors. First, Maryland has a low unemployment rate and there may be few persons seeking work. Second, many biotech firms concentrate their hiring on persons with a Bachelor's degree or higher. If these employers were to recruit persons with either an Associate's degree or training from a certified program, such as BTI, this would potentially create a larger pool of potential applicants. Another part of the problem in filling lower skilled biotech jobs comes from firms viewing applicants to these positions as lacking basic skills and work ethic. As one key informant stated "many of the workers are not trained the way that companies want them trained." These problems can be mitigated through biotech training programs, such as BTI, that work with firms to develop training programs for entry-level biotech workers.

The key informants reported that they expect worker shortages to become more acute in the future. College enrollments are not keeping pace with the growth of the sector and its demand for higher skilled workers. For entry level jobs, key informants reported that

Maryland's schools are not adequately preparing science and technology workers in terms of providing either the required skills or a sufficient number of graduates. Key informants reported that as Maryland's biotechnology sector moves from its current concentration on research and product development into more production-based activities, that there will be greater demand for workers in the manufacturing and production stages. It is not clear that our State or regional education system will be able to meet this demand. There was a belief that in order to better prepare science and technology workers, it was suggested that preparation for these jobs needs to occur in the 8th or 9th grades. Thus, there appears to be a need for both the targeted technical and production training and basic K-12 educational programs performed by BTI.

4.2.2 Other Workforce Problems

The other workforce problems mentioned by interviewees include worker retention and employee turnover. Interviewees noted that workforce shortages are tied to the ability of firms to retain their workforce and that certain levels of employees are more likely to leave after short periods of employment. A problem with retention of workers is often tied to the need for day care and problems with transit and job access among lower-skilled employees. Lower-skilled employees also job hop from one firm to another for higher wages. A suggestion from an interviewee to address the problem of retention was to increase wages paid to lower skilled employees. In addition to the problem of retention, interviewees commented that college graduates often stay for a short period to gain training and experience and then leave to go to another company. This turnover translates into increased training time and costs to the firm.

4.3 Baltimore City Workforce Barriers

Because BTI's core activities are currently targeted in the City, key informants were asked to discuss their perceptions of the key biotechnology workforce issues in the City. Because of the development of the two biotechnology research parks in the City coupled with the existing local capacity of BTI, the Jacob France Institute examined the specific workforce barriers that impede employment opportunities for City residents in the biotechnology sector. These barriers not only prevent City residents from accessing biotechnology jobs and employment opportunities but also result in firms experiencing worker shortages and increased costs associated with hiring, recruiting, and training workers. The barriers mentioned by interviewees ranged from access to transportation to a lack of skills. Overcoming these barriers represents a win-win opportunity for City residents to improve their economic well-being and to promote the development of a key, high wage, high value-added sector within Baltimore City.

The most frequently mentioned barrier for City residents to access biotech job opportunities is that of transportation. Within Baltimore City there are a large number of persons that can fill entry-level positions; however, they need to be able to access these job opportunities. The problem is that many biotech jobs are not located either within the City or directly accessible to mass transit. Another significant barrier to biotech jobs that City residents face is their level of education. Key informants commented the perception that City residents have poor reading and math skills, which are critical to biotechnology jobs. Improving the educational system and the level of skills that students receive in the City schools would improve the ability of residents to access biotechnology job opportunities. Interviewees also commented that they believe the BTI BioStart is a good program that is designed to overcome these basic skill deficits that City residents possess. In addition to this program, more programs designed to bridge the skill gap need to be created and implemented.

Through multiple research projects for various clients, JFI staff has heard that personal, “soft-skill” factors impact the hiring ability of City residents statewide. In conducting the interviews for this project, JFI staff again heard that personal factors, such as lack of work ethic, personal responsibility, and motivation are barriers to biotechnology job opportunities for City residents. Beyond these problems, interviewees believe that many of the City residents that could fill entry-level biotech jobs would not be able to pass the criminal background checks or the drug tests required by many firms. A suggestion to address these personal issues would be to provide basic skills training either through the school system or through workforce development providers. Providing this basic training is not viewed as a service that BTI should provide and should be outside of their core function; however, BTI’s BioStart program was considered to be a potentially important vehicle to improve employment opportunities.

A final barrier to overcome in improving biotechnology employment opportunities for City residents was the lack of biotechnology-related training opportunities for City residents. Three key informants noted that they believe there are greater opportunities for training and education for suburban residents, that training opportunities in the City are not publicized, and that many City residents are not aware of services that they can access. One way to address this is for workforce development and training providers to link together and increase their visibility through advertising campaigns. In addition, it was mentioned that the BTI program would benefit from a full-time staff member charged with marketing the program.

In summary, Baltimore City residents are seen as facing key barriers to employment in the biotechnology sector related to a perceived lack of skills, education and training opportunities. BTI is seen as a means of enhancing job prospects for City residents in the biotechnology sector through both its educational BioStart program and its core training operations. There appears to be both a need and support for increasing the core operations of BTI in these two areas.

4.4 Baltimore City Biotechnology Parks and the Role of BTI

Because of the potential transformational impact of the development of the two university biotechnology-related research parks in Baltimore City, key informants were asked to discuss their perceptions of the impact of the two university biotechnology parks and potential role of BTI in providing the skilled and educated workers needed by the companies locating at the parks. The key informants interviewed view the development of the university biotechnology parks not only as an opportunity to develop Baltimore City and the region’s biotech business base, but potentially as a key driver for biotech growth in the State. The development of Maryland’s biotechnology industry has been clustered around the federal laboratories and regulatory agencies in Montgomery County and the other Washington suburbs, yet much of the business (legal and professional services), healthcare (teaching hospitals and clinical trials capabilities) and university-based research and educational infrastructure are located in Baltimore City. Despite the existence of a strong biotechnology industry support infrastructure in the City, both the City and the region have lagged in the development of this important sector. The development of the two biotechnology-related university research parks, with an estimated 11,000 potential jobs,¹⁰ creates an opportunity to reverse this historical trend.

¹⁰ Jacob France Institute. *The Potential Workforce Development Implications of the Development of the East Baltimore Biotech Park and the UMB Research Park*. January 2003.

The success of these parks is tied not only to generation and commercialization of new technology and formation of university-industry research relationships at the host universities, but also on the availability of a skilled and educated workforce. Both parks when built out are expected to employ as many as 11,000 persons.¹¹ The analysis conducted by the JFI found that as many as 4,070 of these potential jobs would require employees with work experience or on-the-job training as an educational requirement. These lower skilled and entry-level positions can be filled by local Baltimore City residents if they are provided with the required skills. Otherwise, these jobs are likely to be filled by suburban in-commuters. In order to meet the occupational demand generated by the development of the two university biotechnology parks, Baltimore City and the state will need to create a specialized training infrastructure. Key informants reported that BTI is well positioned to play a central role in filling this need and should partner with workforce development agencies, workforce training providers training, universities and the community college to develop training programs.

4.5 Key Informant Perceptions of the BioTechnical Institute of Maryland

Overall, key informant had a very positive view of the BTI program and those with experience hiring graduates reported that they were satisfied with the workers hired. Firms that hired BTI graduates were asked about their level of satisfaction with these workers, and if there were any problems with these graduates. Foundations, workforce development providers, and government agencies were asked about their opinion of BTI and its programs.

The BTI program is seen by businesses, foundations, and related workforce development professionals as an important provider of lower-skilled, entry-level biotech workers that are currently in short supply. Firms commented that they were satisfied with the graduates from the BTI program and that many would continue to look to BTI to provide these workers. Key informants commented that BTI is successful at providing introductory biotechnology training to City residents and with providing persons in the program with a solid skill base that allows graduates to perform specific, entry-level biotechnology positions. Additionally, the BTI program serves as a screener of job applicants to biotech firms. One firm commented that the program allows them to check the applicants for needed skills.

While many of the firms commented that they would continue to hire BTI graduates, they also noted that they experienced several problems with some of the graduates that they had hired. These problems were not considered significant enough to refuse to hire future BTI graduates, but if addressed, would result in a more favorable opinion of the BTI program and its graduates. The problems that firms expressed are of two types. The first is related to the training provided and the second is related to personal performance issues.

Employers mentioned that they believe the BTI program provides a good introductory level of training to its students. But, this level of training is often not enough for a firm's needs. Firms commented that often the skills that are needed for employment in biotechnology cannot be learned in a period of six to 12 weeks and that additional time is required for certain procedures and topics. Additionally, the program does not provide an introduction into the biotechnology industry and certain skills, such as transcribing and technical documentation are not taught in the program. Another problem tied to the program is that often firms do not hire persons with less than an Associates or Bachelor's degree. If firms are willing to hire persons

¹¹ Jacob France Institute. *The Potential Workforce Development Implications of the Development of the East Baltimore Biotech Park and the UMB Research Park*. January 2003.

with less than a Bachelor's degree, they need to be assured that BTI graduates receive sufficient hands-on and in-depth training.

The second type of problem experienced by employers relates to employee personal performance issues and was a more frequently cited problem than training or skill levels. These problems include a lack of personal responsibility, work ethic, or a lack of soft skills. Specific examples provided by firms included problems with drug usage, employees lacking interviewing skills, employees not dressing professionally, and a high number of work absences. Most frequently cited was that many of the BTI graduates lacked a strong work ethic. This was especially problematic in that the positions that they were hired for involved repetitive procedures and require a high level of detail and attention. These types of problems may be outside the ability of the BTI program to address. A solution to these problems may be in partnering with agencies that already provide training for these types of problems.

4.6 Recommendations for BTI

Biotechnology is not only an important industry in Maryland, but it is also a focus of statewide economic development efforts and is viewed as an important industry that will shape Maryland's future. The key informants interviewed for this study commented that they believe the biotechnology industry will continue to grow and that both the Washington region and the Baltimore area will continue to further develop their base of biotechnology companies. A key driver to this growth will be opportunities created from federal labs and agencies, academic research institutions, and the development of the two university biotechnology parks in Baltimore City. While opportunity exists, biotechnology workforce shortages may impede growth. Biotechnology worker shortages appear to be in both skilled and unskilled biotech positions and if not addressed now, can be estimated to worsen as the biotechnology industry grows in Maryland. The BTI program is viewed as an important partner not only in addressing lower skilled worker shortages, but in providing a skilled biotech workforce in the Baltimore region and for potentially all of Maryland.

Through these interviews, numerous suggestions were made as to how BTI can better train workers, supply biotech businesses with skilled employees, and strengthen overall operations. These suggestions typically fell into three categories: 1) improve the skills and employability of BTI graduates; 2) provide customized training to biotech firms; and 3) general ways to improve the BTI program.

Improve the Skills and Employability of BTI Graduates

While many of the interviewees believe that the BTI program produces skilled technicians, suggestions were made as how to improve upon the skills and employability of these graduates. These suggestions included:

- Surveying biotechnology businesses as to the skill sets required by their entry-level employees and technicians.
- Provide refresher classes for those graduates not immediately hired after program completion.
- Make the BTI program more hands-on and teach more about the underlying theories.

- Include teaching additional techniques as part of the program. These may include surgical techniques, cell culture, buffer and re-agent preparation, and clinical practice training.
- Include soft and other skills training as a program component. These may include scientific resume writing, interviewing skills, and personal responsibility. It was suggested that these types of skills could be taught to program participants through partnering with workforce development providers and other skills training providers that already have existing programs.

Provide Customized Training to Biotechnology Firms

A second type of suggestion that was made was for BTI to provide continuing education or customized training to biotech firms and educational institutions. Interviewees believed that providing these types of customized and continuing education programs could be a potential source of revenue for the BTI program. It was suggested that BTI could provide two types of training programs.

- Provide business related training. One workforce need mentioned by interviewees was that there is a shortage of biotech persons with business skills. BTI could look to provide business skills training, such as in quality control and manufacturing processes, to biotech firms with this need.
- Provide customized training in biotechnology technologies and techniques. The specific training programs where BTI could play a role mentioned by key informants included: micro ray technology; genetics; lab safety; aseptic technique; and cell culture training.

General Improvements to the BTI Program

The third major area of recommendations made was on ways that BTI can improve its overall program. These suggestions were either related to their current training programs or were strategic suggestions to improve the overall viability of BTI. The suggestions related to their current training programs included:

- Lengthening their current training programs to coincide with the academic calendar.
- Work with educational institutions so that their training counts as part of an Associates degree or a Bachelor's degree. This is especially important in that many firms reportedly do not hire entry-level biotechnology workers that have less than a Bachelor's degree. (note this has been accomplished with Baltimore City and is pending with the Community Colleges of Baltimore County.
- Use the most current techniques and technologies in their training programs and have students work in internships (preferably paid) earlier in their program.
- As a means to address some of the barriers that City residents face, interviewees suggested providing student stipends and paying for student's transit.
- Work closer with technical worker placement agencies, establishing mentoring programs for students, and lining up positions in biotech firms for students prior to their graduating. In this case, BTI would receive a commitment from a firm for a specific number of persons that they will hire from the training program before the students start the BTI program.

Suggestions to improve the overall viability of BTI included:

- Developing BTI training programs located in suburban jurisdictions, such as Frederick County, where biotechnology firm and employment growth is projected. Developing training programs in suburban locations would address workforce shortages tied to problems with access to mass transit.
- Working closer with biotechnology businesses and industry associations.
- Increase the staff of BTI by adding more administrative support staff and trainers. Administrative support staff would include hiring a staff member committed to developing marketing materials, brochures, and improving the visibility of the BTI program.
- Improve the sustainability of the BTI program. Ways to accomplish this could be found through completing a market analysis and examining other biotech training programs nationally and in finding new sources of funding for the program.

4.7 Conclusion of BTI Key Informant Interviews

Maryland's location, workforce, and business-friendly environment lend strength to the State's biotechnology community and will assist in its future growth. The two biotech parks located in Baltimore City represent an opportunity for the growth of the industry in the Baltimore region. This opportunity is not guaranteed. Various workforce problems may hinder the ability of existing biotech firms to grow. These problems include workforce shortages for both skilled and lower-skilled employees. The lower-skilled workforce shortages can be reduced by accessing the pool of Baltimore City residents that can potentially graduate from the BTI program. But, the City has its own set of workforce problems, including the inability of workers to access suburban biotech job openings. Overcoming this and other workforce problems would address a major current and future projected need of biotech firms. Since the BTI program is viewed as an important provider of entry-level biotech workers, improving the program by improving the training students receive or by strategically improving BTI's viability may be ways to address the workforce problems of biotech firms. Through improving the BTI program the opportunities presented by the Biotech parks in the Baltimore region will be realized and the industry will continue its growth and development.

5.0 BTI Workforce Impacts

The JFI prepared an analysis of the employment status and earnings of all of BTI's graduates using the Maryland Wage Record Archive. The JFI was able to track the employment status and earnings of all BTI graduates working in Maryland's private sector.¹² Data was tracked for all 158 BTI graduates from a total of seventeen classes between 1997 and 2005. The results of this analysis are presented in Table 6 for employment status and Table 7 for earnings levels. Graphs tracking employment and earnings trends across these cohorts are included as Appendix C.

Table 6 presents the pre- and post-BTI training employment status for all BTI graduates. Most BTI graduates were employed before enrolling in training. All but one cohort experienced

¹² The Wage Record Archive tracks earnings for "covered workers" eligible for unemployment insurance. It does not include federal employers or certain other workers. Most employers who hire BTI graduates are included, but workers who leave the State or become employed by federal agencies are not included.

fairly large gains in employment in the quarter immediately following training. Post training employment ranged from a low of 43% for one cohort to 100% for three cohorts. For 12 of the 17 cohorts, more than three-quarters (75%) of graduates were employed in the immediate post-training quarter. The JFI also tracked employment status for all graduates as of the fourth quarter of 2005. Seventy-three percent (73%) of all 158 BTI graduates from 1997 to 2005 period were employed in the fourth quarter of 2005, and for all but two cohorts, employment status in the fourth quarter of 2005 exceeded pre-enrollment levels.

Table 7 presents the pre and post BTI training average earnings for all BTI graduates. For 15 of the 17 cohorts, the earnings in the first full quarter of employment after BTI training were higher than pre-training levels. The average pre-post training earnings differential ranged from a loss of \$457 to a high of \$4,186, with an average gain of \$1,301. Comparing earnings in the year (four quarters) after completion of the BTI program to the year (four quarters) before training yields a much higher earnings differential. The pre-BTI training annual earnings for all cohorts ranged from a low of \$8,429 to a high of \$18,658 with an average across all cohorts of \$12,953. The post-BTI training annual earnings for all cohorts ranged from a low of \$16,716 to a high of \$22,832 with an average across all cohorts of \$19,614. The average annual post-BTI gain in earnings was \$6,661 across all cohorts. The JFI also tracked earnings for each cohort in calendar 2005. Some of the earlier cohorts that completed BTI training in 1998-2000 have 2005 earnings above \$30,000 per year and high levels of 2005 employment (60% to 100% from Table 6). The progression of earnings among cohorts (presented in Table 6) and of earnings for each cohort (presented in the graphs in Appendix C) show that BTI graduates have real earnings growth potential.

The JFI also tracked BTI graduate employment tenure (the length of time with and number of employers). This analysis was complicated by the fact that many BTI graduates go on to work for personnel services firms. In many cases, these BTI graduates change the employment service that they work for or are hired by the firm they are placed with, leading to multiple employer changes for some graduates. The BTI graduates placed with larger employers, such as Johns Hopkins, Chesapeake Biological Labs, Cambrex (now Lonza), and Becton Dickinson, tended to have longer periods of job tenure with a single employer.

The BTI program has demonstrated significant success with improving both employment status and earnings levels of its graduates. There are no evaluations of comparable biotechnology-oriented training programs in the region or in the nation; indeed the JFI was unable to identify similar programs to BTI outside of community colleges. However, the results of BTI can be compared to evaluations of other local workforce development programs. The pre-/post- earnings gains for BTI are comparable to the results from an analysis of the return on investment of Baltimore City training programs that was conducted as part of the 2004 *Baltimore's Workforce System at Work Report*.¹³ This report found similar increases in participant earnings – an annual increase in earnings of \$7,154 for the employed workers studied (\$9,669 for customized training and \$5,572 for Individual Training Accounts- ITA) which is similar for the annual increase of \$6,661 for the BTI's 17 cohorts. The increased earnings impacts of the BTI training exceeds the earnings gains found in a national study of the impact of

¹³ <http://www.baltoworkforce.com/resources.htm>

the Workforce Investment Act (WIA), which found a \$3,136 increase in annual earnings from WIA intensive/training services.¹⁴

BTI has a demonstrated track record in training Baltimore City residents, many that are from hard to serve communities, and in placing them in jobs. 80% of the BTI graduates are employed in the quarter immediately following training and experience an average \$6,661 increase in annual earnings. BTI graduates have a demonstrated track record of success in earnings growth and most earn a wage above the poverty line.

¹⁴ Unpublished ADARE Program materials.

Table 6
Cohort Earnings Analysis
BioTechnical Institute of Maryland
Employment Status

Class Dates		% Employed Pre-Training Quarter	% Employed Post-Training Full Quarter	Difference	% Employed 2005:Q4	Difference From Pre-Training
Cohort 1	Sept 1997- Jan 1998	86%	100%	14%	86%	0%
Cohort 2	June - Sept 1999	60%	80%	20%	60%	0%
Cohort 3	Nov 1999 - Jan 2000	43%	100%	57%	100%	57%
Cohort 4	Jan - April 2000	44%	89%	44%	89%	44%
Cohort 5	May - July 2000	50%	92%	42%	83%	33%
Cohort 6	Aug - Nov 2000	70%	80%	10%	40%	(30%)
Cohort 7	Jan - March 2001	70%	80%	10%	70%	0%
Cohort 8	April - June 2001	43%	43%	0%	71%	29%
Cohort 9	July - Oct 2001	22%	67%	44%	67%	44%
Cohort 10	Jan - April 2002	80%	90%	10%	70%	(10%)
Cohort 11	April - July 2002	55%	82%	27%	64%	9%
Cohort 12	July - Oct 2002	67%	83%	17%	75%	8%
Cohort 13	Feb - May 2003	45%	73%	27%	55%	9%
Cohort 14	Sept - Dec 2003	100%	86%	(14%)	100%	0%
Cohort 15	Feb - May 2004	50%	100%	50%	83%	33%
Cohort 16	June - Sept. 2004	69%	69%	0%	77%	8%
Cohort 17	Sept - Dec. 2004	44%	56%	11%	78%	33%

Source: The Jacob France Institute

Table 7
Cohort Earnings Analysis
BioTechnical Institute of Maryland
Quarterly and Annual Earnings

Class Dates		Average	Average	Difference	Average	Average	Difference	2005
		Earnings	Earnings		Earnings	Earnings		Average
		Pre-Training	Post-Training		Pre-Training	Post-Training		Annual
		Full Quarter	Full Quarter		Four Quarters	Four Quarters		Earnings
Cohort 1	Sept 1997- Jan 1998	\$3,550	\$4,924	\$1,374	\$15,986	\$19,548	\$3,562	\$29,028
Cohort 2	June - Sept 1999	\$3,265	\$3,680	\$414	\$11,638	\$19,230	\$7,592	\$31,520
Cohort 3	Nov 1999 - Jan 2000	\$2,624	\$3,464	\$840	\$10,712	\$17,568	\$6,856	\$24,401
Cohort 4	Jan - April 2000	\$2,433	\$5,373	\$2,940	\$8,760	\$21,096	\$12,336	\$30,478
Cohort 5	May - July 2000	\$1,868	\$4,036	\$2,167	\$8,429	\$19,710	\$11,282	\$27,039
Cohort 6	Aug - Nov 2000	\$2,977	\$4,415	\$1,438	\$12,844	\$19,640	\$6,796	\$22,927
Cohort 7	Jan - March 2001	\$2,958	\$3,979	\$1,021	\$15,106	\$22,832	\$7,726	\$27,986
Cohort 8	April - June 2001	\$3,447	\$2,989	(\$459)	\$12,581	\$16,716	\$4,135	\$28,104
Cohort 9	July - Oct 2001	\$1,076	\$5,262	\$4,186	\$9,201	\$20,219	\$11,019	\$25,048
Cohort 10	Jan - April 2002	\$2,327	\$3,448	\$1,121	\$9,387	\$17,024	\$7,637	\$24,103
Cohort 11	April - July 2002	\$3,954	\$4,878	\$924	\$17,351	\$20,901	\$3,550	\$23,769
Cohort 12	July - Oct 2002	\$5,183	\$5,006	(\$177)	\$18,658	\$22,572	\$3,914	\$24,760
Cohort 13	Feb - May 2003	\$2,090	\$4,282	\$2,192	\$15,157	\$18,595	\$3,438	\$23,759
Cohort 14	Sept - Dec 2003	\$3,613	\$3,718	\$105	\$14,596	\$21,262	\$6,665	\$21,915
Cohort 15	Feb - May 2004	\$4,109	\$5,273	\$1,164	\$10,060	\$21,016	\$10,956	\$22,310
Cohort 16	June - Sept. 2004	\$2,971	\$4,146	\$1,176	\$14,623	\$17,338	\$2,715	\$18,711
Cohort 17	Sept - Dec. 2004	\$2,893	\$4,588	\$1,695	\$15,119	\$18,176	\$3,056	\$18,176

Source: The Jacob France Institute

6.0 Strategic Options

The JFI has also developed several high level strategic options that BTI may choose to pursue to expand its capabilities to meet the needs of the biotechnology community and city residents. These include:

1. *Pursue a relationship with the Maryland Department of Business and Economic Development (DBED). DBED funds employer training programs under its Maryland Industrial Training Partnership (MITP) and Partnership for Workforce Quality (PWQ) programs. These programs are targeted on assisting the technology and manufacturing companies that hire BTI graduates. BTI should work with DBED to become a vendor or specialized employer-based training service that can be brought in to provide training to targeted biosciences employers under MITP or PWQ.*
2. *Other areas, such as Frederick County and Prince George’s County, are experiencing growth in their biotechnology sector but lack training programs. BTI should explore opportunities to work with the workforce and economic development organizations to provide needed training services. Because, unlike Baltimore City, many other Maryland jurisdictions do not have the large concentration of hard to serve populations or experience in working with independent workforce development systems, BTI should explore working with community colleges in these areas.*
3. *BTI’s BioStart program is beginning to work with City public schools. Career-based education is becoming a major thrust across the state of Maryland. BTI could work with the Maryland State Department of Education (MSDE) and the biotechnology industry to develop and implement high school-based biosciences training in other Maryland jurisdictions. There are numerous examples across the nation of high school biotechnology programs, but Maryland lacks a statewide effort. BTI could work with MSDE, MDBio, the technology councils and the Maryland Business Roundtable for Education to take the lead in coordinating and working with all of the relevant players to develop a world-class biotechnology middle-to-high school program. Such effort can often be funded through federal or state grants.*
4. *In the interviews, key informants noted that there is a shortage of business managers with the sciences skills needed by technology companies. BTI could partner with businesses or colleges and universities to provide some level of basic biosciences training to incoming new business hires.*
5. *The District of Columbia has a similar concentration of hard to serve populations as in Baltimore. While the District lacks Baltimore’s concentration of biotechnology resources, it is in the center of a major regional biotechnology and high technology cluster in its Maryland and Virginia suburbs. BTI could explore the development of training programs in the District.*

7.0 Summary and Conclusion

BioTechnical Institute of Maryland is a proven workforce development services and training provider. It has nearly a decade of experience of providing training to Baltimore City residents for jobs in which there is a substantial unmet need for workers. BTI has overcome the initial reluctance of many biotechnology employers to hire technicians with less than an Associates or Bachelors degree or community college certificate or to hire City residents. The BTI has a

placement record that meets or exceeds local standards in terms of post-training earnings growth and a strong record of continued employment with both non-poverty wages and a record of continued earnings growth for its graduates. BTI can assist in meeting the needs of the State and region's growing biotechnology sector for entry-level technical personnel. While BTI can not solve the education, training, or employment gaps existing between City residents and the rest of Maryland, BTI's training programs can be expanded to allow more City residents to benefit from the growth of one of the City, region and State's leading industries. Its model of hands on, employer based training can and should be expanded to other parts of the State.

Appendix A

Occupational Description - Biotechnology Related Technician Occupations From U.S. Bureau of Labor – O-Net

Biological Technicians

2,290 Annual Openings

Assist biological and medical scientists in laboratories. Set up, operate, and maintain laboratory instruments and equipment, monitor experiments, make observations, and calculate and record results. May analyze organic substances, such as blood, food, and drugs.

Baltimore Metro Median Annual Salary: \$35,400

Education and Training Requirements

Overall Experience	A minimum of two to four years of work-related skill, knowledge, or experience is needed for these occupations.
Job Training	Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.
Education	Most of these occupations require a four - year bachelor's degree, but some do not.

Occupational Requirements

- Keep detailed logs of all work-related activities.
- Monitor laboratory work to ensure compliance with set standards.
- Isolate, identify and prepare specimens for examination.
- Use computers, computer-interfaced equipment, robotics or high-technology industrial applications to perform work duties.
- Conduct research or assist in the conduct of research, including the collection of information and samples, such as blood, water, soil, plants and animals.
- Set up, adjust, calibrate, clean, maintain, and troubleshoot laboratory and field equipment.
- Provide technical support and services for scientists and engineers working in fields such as agriculture, environmental science, resource management, biology, and health sciences.
- Clean, maintain and prepare supplies and work areas.
- Participate in the research, development, or manufacturing of medicinal and pharmaceutical preparations.
- Conduct standardized biological, microbiological or biochemical tests and laboratory analyses to evaluate the quantity or quality of physical or chemical substances in food or other products.

Required Skills

Skills	Skill Definitions
Science	Using scientific rules and methods to solve problems.
Reading Comprehension	Understanding written sentences and paragraphs in work related documents.
Instructing	Teaching others how to do something
Active Learning	Understanding the implications of new information both current and future problem-solving.
Learning Strategies	Selecting and using training/instructional methods and procedures appropriate for the situation.
Time Management	Managing one's own time and the time of others.
Active Listening	Giving full attention to what other people are saying, and taking the time to understand the points being made.
Mathematics	Using mathematics to solve problems.
Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
Speaking	Talking to others to convey information effectively.

Life, Physical and Social Science Technicians 4,515 Annual Openings

Baltimore Metro Median Annual Salary: \$40,500

Medical and Clinical Lab Technicians 3,645 Annual Openings

Perform routine medical laboratory tests for the diagnosis, treatment, and prevention of disease. May work under the supervision of a medical technologist.

Baltimore Metro Median Annual Salary: \$33,800

Education and Training Requirements

Overall Experience	Some previous work-related skill, knowledge, or experience may be helpful, but usually is not needed.
Job Training	Employees in these occupations need anywhere from a few months to one year of working with experienced employees.
Education	These occupations usually require a high school diploma and may require vocational training or job-related course work. Associate's or Bachelors could be needed.

Occupational Requirements

- Conduct chemical analyses of body fluids, such as blood and urine, using microscope or automatic analyzer to detect abnormalities or diseases, and enter findings into computer.
- Set up, adjust, maintain and clean medical laboratory equipment.
- Analyze the results of tests and experiments to ensure conformity to specifications, using special mechanical and electrical devices.
- Analyze and record test data to issue reports that use charts, graphs and narratives.
- Conduct blood tests for transfusion purposes and perform blood counts.
- Obtain specimens, cultivating, isolating and identifying microorganisms for analysis.
- Examine cells stained with dye to locate abnormalities.
- Collect blood or tissue samples from patients, observing principles of asepsis to obtain blood sample.
- Consult with a pathologist to determine a final diagnosis when abnormal cells are found.
- Inoculate fertilized eggs, broths, or other bacteriological media with organisms.

Required Skills

Skills	Skill Definitions
Science	Using scientific rules and methods to solve problems.
Reading Comprehension	Understanding written sentences and paragraphs in work related documents.
Operation and Control	Controlling operations of equipment or systems.
Equipment Maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance.
Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
Speaking	Talking to others to convey information effectively.
Active Listening	Giving full attention to what other people are saying. and taking the time to understand the points being made.
Monitoring	Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements.
Instructing	Teaching others how to do something.
Time Management	Managing one's own time and the time of others.

Medical and Clinical Lab Technologists

3,245 Annual Openings

Perform complex medical laboratory tests for diagnosis, treatment, and prevention of disease. May train or supervise staff.

Baltimore Metro Median Annual Salary: \$52,100

Education and Training Requirements

Overall Experience	A minimum of two to four years of work-related skill, knowledge, or experience is needed for these occupations.
Job Training	Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.
Education	Most of these occupations require a four - year bachelor's degree, but some do not.

Occupational Requirements

- Analyze laboratory findings to check the accuracy of the results.
- Conduct chemical analysis of body fluids, including blood, urine, and spinal fluid, to determine presence of normal and abnormal components.
- Operate, calibrate and maintain equipment used in quantitative and qualitative analysis, such as spectrophotometers, calorimeters, flame photometers, and computer-controlled analyzers.
- Enter data from analysis of medical tests and clinical results into computer for storage.
- Analyze samples of biological material for chemical content or reaction.
- Establish and monitor programs to ensure the accuracy of laboratory results.
- Set up, clean, and maintain laboratory equipment.
- Provide technical information about test results to physicians, family members and researchers.
- Supervise, train, and direct lab assistants, medical and clinical laboratory technicians and technologists, and other medical laboratory workers engaged in laboratory testing.
- Develop, standardize, evaluate, and modify procedures, techniques and tests used in the analysis of specimens and in medical laboratory experiments.

Required Skills

Skills	Skill Definitions
Science	Using scientific rules and methods to solve problems.
Reading Comprehension	Understanding written sentences and paragraphs in work related documents.
Operation and Control	Controlling operations of equipment or systems.
Equipment Maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance.
Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
Troubleshooting	Determining causes of errors and deciding what to do.
Active Listening	Giving full attention to what other people are saying. and taking the time to understand the points being made.
Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
Operation Monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly.
Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

Appendix B Maryland Community College Biotechnology Programs

Introduction

The JFI collected available information on biotechnology training programs that exist in Maryland. While there are training programs that exist for higher skilled and higher educated workers, such as the Maryland Biotechnology Program run by the University of Maryland, College Park, offering advanced degrees, certificate programs, and customized workforce training, there are few programs that exist for entry-level employees. In speaking with the Bioscience Industry Initiative Coordinator of the Governor's Workforce Investment Board (GWIB), Bernard Reynolds, he was unaware of any entry-level or low-skilled biotechnology workforce training programs that exist in Maryland other than the BTI programs. The only other lower-skilled biotech training programs that have been identified by the JFI are Community College degree and certificate programs. This section of the report describes the programs that are offered by Maryland Community Colleges.

Currently, there are six Community Colleges in Maryland that offer biotechnology programs and one Community College that will be starting a new biotech program. Table 8 lists the Community College Programs, the degree type, and the number of credit hours required. The Community Colleges that have existing programs are Allegany College, Baltimore City, Baltimore County (Catonsville), Southern Maryland, Howard, and Montgomery College (Germantown). Frederick Community College and Howard Community College will be starting new programs in fall 2007. The requirements and the number of credit hours vary for each program. In speaking to each Community College about their biotechnology programs, they were designed for each program's coursework to be completely transferable to a Bachelor's degree program.

**Table 8
Maryland Community College Biotechnology Programs**

Community College	Program Name	Degree Type	Credit Hours
Existing Programs			
Allegany College of Maryland	Medical Laboratory Technician - Biotechnology	Certificate	13
	Medical Laboratory Technician - Biotechnology	AAS	68
	Medical Laboratory Technician - Biotechnology	AAS & Certificate	79
	Medical Laboratory Technician - Biotechnology	AAS (Double)	90-93
Baltimore City	Biotechnology	AAS	62-65
Baltimore County - Catonsville	Biotechnology Laboratory Technician	Certificate	17-21
	Biotechnology and Biomanufacturing	AAS	60
College of Southern Maryland	Arts and Science Biotechnology	AA	62-64
Howard	Biotechnology	AA	64-66
Montgomery College - Germantown	Biotechnology	Certificate	20
	Biotechnology	AAS	61-62
Planned Programs			
Frederick	Bioprocessing Technology	AAS	60-64
	Bioprocessing Technology	Certificate	39
Howard	Bioinformatics	AA	60

Allegany College of Maryland

Allegany College of Maryland is located in Cumberland and offers a biotechnology option through its Medical Laboratory Technology program. According to Allegany College, the biotechnology option provides a way to broaden the preparation of the laboratory worker for environmental, epidemiological, industrial and research laboratories in addition to the clinical laboratory. Courses provide students with experience in such areas as immunoassay, DNA and RNA isolation, RFLP, blotting, cell preparation and transformation. There are three options for students who choose to pursue the biotechnology option. These options are:

1. Medical Laboratory Technician – Biotechnology Certificate

This program requires the MLT student to complete an additional 13 credit hours in biological science and medical laboratory technology classes. The Certificate program was designed to increase the marketability of MLT students and to update the skill sets of recent graduates.

2. Medical Laboratory Technician – Biotechnology AAS

This program requires the MLT student to complete a total of 68 credit hours of integrated medical laboratory technology and biological science classes.

3. Medical Laboratory Technician and Biotechnology Option – Blended Curriculum

This program offers graduates the greatest amount of career flexibility. Students can choose to earn either a MLT degree and a Biotechnology certificate (requiring a total of 79 credit hours) or dual MLT and Biotechnology AAS degrees (requiring a total of 90 to 93 credit hours). Courses provide students with experience in such areas as immunoassay, DNA and RNA isolation, RFLP, blotting, cell preparation and transformation in addition to preparing the graduate to be eligible for national certification as a Clinical Lab Technician/Medical Lab Technician.

Baltimore City Community College

The Baltimore City Community College offers a Biotechnology AAS degree. The program requires a total of between 62 to 65 credit hours in science laboratory technical skills. The program also serves as the first two years of preparation for a four-year school with a major in physical or biological sciences. BTI graduates earn 6 credit hours applicable at BCCC.

Community College of Baltimore County

The Catonsville campus of the Community College offers two Biotechnology related programs. These programs are a Biotechnology Laboratory Technician certificate program requiring between 17 to 21 credit hours and a Biotechnology and Biomanufacturing AAS degree requiring 60 credit hours. The certificate is designed primarily for non-degree seeking students, individuals switching careers, displaced workers, or those already in the field seeking advancement. Individuals completing either program are well prepared for technical careers in the health sciences, basic research, pharmaceutical research and development, production and manufacturing, and quality assurance. Students electing the AAS option can elect courses that will fulfill degree requirements at four-year colleges and universities. Students interested in entering directly into the workforce can take alternative courses and electives. The “core” of the program consists of three sequential courses that cover the discovery, development, and production of a modern biopharmaceutical. Students enrolled in these courses can expect to

learn about the new drug approval process including the regulatory requirements, laboratory and production documentation, laboratory techniques including recombinant DNA, electrophoresis, enzyme assays, protein purification, cell culture, and quality control methods employed in the biotechnology industry. Capstone projects bring together the skills and knowledge taught during the program as students engage in mini-research projects and produces a “cGMP compliant” biopharmaceutical.

Currently, the Biotechnology certificate and AAS degree programs are only offered at the Catonsville campus. There has been discussion about replicating these programs at the Essex campus due to the projected demand for biotechnology graduates in Baltimore and Harford Counties. Biotechnology and pharmaceutical firms are being targeted for recruitment along the Route 43 expansion linking White Marsh to Middle River and could access the both training and graduates provided by the Essex campus.

College of Southern Maryland

The College of Southern Maryland, at their La Plata campus, offers an Associates of Arts degree in Biotechnology. This program is designed for part- and full-time students with a specific academic and/or professional interest in the areas of biotechnology, microbiology, and genetics. The program requires a total of 62 to 64 credit hours. The Biotechnology program introduces this discipline within the context of allied subject areas, preparing students for specific concentration at a four-year Maryland state college or university.

Howard Community College

Howard Community College offers an AA degree program in Biotechnology requiring a total of 64 to 66 credit hours of coursework. The biotechnology program is suitable for students planning to seek employment as laboratory technicians in industrial and research laboratories. Graduates of this program should be able to carry out laboratory procedures, properly use laboratory apparatus and perform basic calculations.

In addition to the Biotechnology degree program, Howard Community College is starting a Bioinformatics AA degree program requiring a total of 60 credit hours. The curriculum is designed for students planning to transfer to a four-year institution to complete a bachelor's degree in Bioinformatics. This new program melds the fields of biological sciences and technology so that data, its discovery, manipulation, storage, and extension can be accomplished. The emphasis is on the use and handling of data. Technical development will include basic knowledge of programming languages, databases and Internet. Graduates would find careers in pharmaceutical and biotechnology industries. The program will include concentration on general studies, biological foundations, and computer science.

Montgomery College

The Germantown campus of Montgomery College offers both a certificate and an AAS in Biotechnology. The Certificate program requires a total of 20 credit hours and the AAS program requires 61 to 62 credit hours of coursework. The Biotechnology certificate curriculum is intended to prepare people for immediate employment in the biotechnology field. This curriculum is suitable for students currently working in the biotechnology or medical technology field who want to upgrade or update their skills or for those who have obtained a bachelor's degree in the life sciences and want additional training.

The emphasis of the Biotechnology AAS program is on applied laboratory skills relevant to the biotechnology industry. A solid foundation is obtained through introductory course work in biotechnology, biology, chemistry, and mathematics. These background courses prepare students for more rigorous upper-level applied course work in biotechnology, biology, and chemistry taken during the second year. On completion of three or more biotechnology classes with a GPA of 2.5 or better and with consent of the biotechnology coordinator, the student has the option of applying to enroll in the biotechnology practicums for off-campus training at local partner biotechnology companies. This option must be selected within six months of completing the on-campus courses. These practicums often result in full-time employment opportunities.

Frederick Community College

In the fall of 2007, Frederick Community College will be starting a Certificate and AAS degree program in Bioprocessing Technology. The Bioprocessing Technology program will prepare individuals to work as process operators in biological products manufacturing facilities. Students in this program will combine basic science and communication skills, manufacturing technologies and good manufacturing practices in the course of study. Students will also develop a strong basic science foundation with a sound understanding of the major technologies employed in the industry. The Certificate program will require a total of 39 credit hours and the AAS degree will require between 60 to 64 credit hours.

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