Charting New Directions

Maryland Bioscience

Workforce Report and Recommendations

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Governor's Workforce Investment Board

Maryland's Bioscience Industry Sector: Workforce Report and Recommendations

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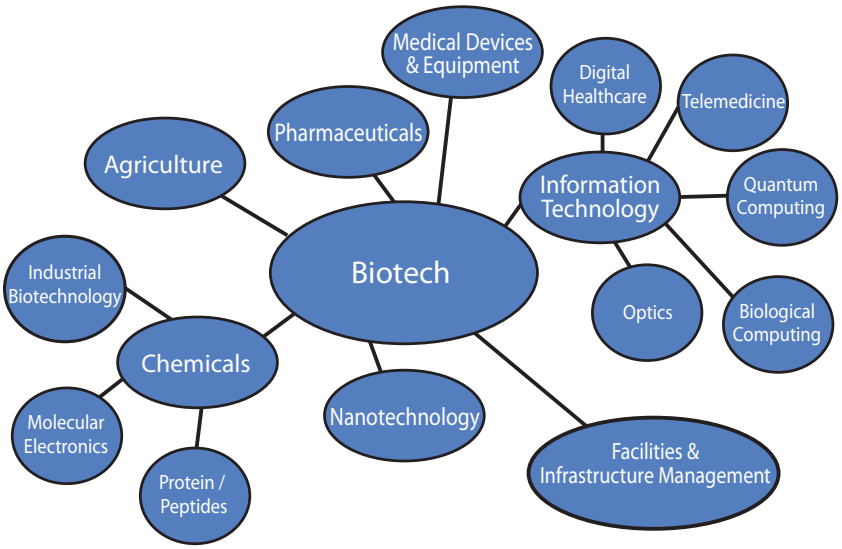
The Bioscience Industry

Bioscience is a young, emerging industry - about thirty-years-old. The industry is made up of a diverse group of companies that create new products, treatments, systems, drugs, diagnostics, medical devices, foods and fuels using the knowledge of how living organisms function. Bioscience companies develop medical therapies and vaccines. They create diagnostic systems that can help people detect cancer and diabetes in their early stages. Biopesticides help crops grow without chemicals and environmental bioscience products help purify water and clean up hazardous waste. The industry is complex and relies on the support of tiers of vendors and suppliers. Its reach extends from basic research on plant, animal, and marine life sciences to drug discovery and information technologies used to support gene research. The bioscience industry's potential has been barely realized, yet its impact is broad.

Defining Bioscience

There is no single definition of bioscience. The industry lends itself to combinations and permutations. Biotechnology and life science companies partner and blend, as do biotechnology and pharmaceutical companies. Applications of technologies bring biotechnology and nanotechnology firms together, and intensive data processing performed by companies specializing in this function suggest that bioinformatics should also have a place at the table.

Figure 1: The Evolving 21st Century Biotech Industry



Source: New Economy Strategies

Consulting groups, industry organizations, and individual companies have slightly different definitions, but there are common threads that weave throughout the industry. For instance, one definition states that the bioscience industry includes research and development of products using technologies that "capitalize on the attributes of cells, such as their manufacturing capabilities, and put biological molecules, such as DNA and proteins, to work for us."[1] A second definition describes bioscience as "the use of cellular and biomolecular processes to solve problems or make useful products," and emphasizes that the "unity of life at the cellular level provides the foundation for biotechnology."[2]

For the purposes of this monograph, and in concert with many public and private organizations in Maryland, the Bioscience Industry Initiative Steering Committee will use the following definition developed by MdBio.

A bioscience company is one that "is biology-driven, and its activity substantially involves research, development or manufacture of:

1) *Biologically active molecules;*
2) *Devices that employ or affect biological processes;*
3) *Biological information or resources; or*
4) *Software designed specifically for biological applications."*[3]

The Bioscience Industry – A National Overview

The biosciences industry is global, with skilled researchers in one country and product manufacturing taking place half a world away. The United States leads this global industry, dominating in medical research and outperforming every nation in most measures related to biotechnology, pharmaceuticals and medical devices, instruments and equipment. "The strong U.S. position is attributed to its research strengths, entrepreneurial culture and internal demand for pharmaceutical products."[4] As a result, the United States attracts foreign nationals from around the globe seeking training and work in the U.S. bioscience industry; and like other industries recruiting foreign nationals to fill specific, highly skilled jobs, is grappling with the limited number of available H-1B visas.

The Bioscience Industry – A Maryland Overview

The Brookings Institution survey of metro areas with bioscience activity states that "The U.S. biotechnology industry is concentrated largely within nine metropolitan areas: Boston, Los Angeles, New York, Philadelphia, Raleigh-Durham, San Diego, San Francisco, Seattle, and Washington/Baltimore. These nine areas account for more than three-fifths of National Institutes of Health (NIH) spending on research and for slightly less than two-thirds of all biotechnology-related patents."[5] These areas are also the hubs for commercialization - the transfer of concepts taken from basic research into actual products or processes. "More than three-fourths of all biotech firms with 100 or more employees, and those firms founded in the past decade, are in one of these nine areas; the same areas account for eight of every nine dollars in venture capital for biopharmaceuticals and for 95 percent of the dollars in research alliances."[6]

Against the Brookings designated metropolitan areas, Baltimore/Washington ranks:

- 3rd in the number of biotechnology firms in the country;
- 3rd for research, testing and labs employment including diagnostics; and
- 5th for biotechnology employment.[7]

Emerging industries like bioscience require special conditions to develop and grow. Most experts contend that few metro areas have the 'critical mass' of factors required to support a dynamic bioscience cluster. The factors large hubs have in common include:

- a highly educated population;
- a strong base of universities and institutes where scientists pursue new research and discovery;
- access to capital to fuel business formation and growth;
- an entrepreneurial culture;
- one or more large bioscience firms; and
- a community of biotechnology firms.[8]

Maryland is fortunate to have all these ingredients, and an additional plus factor for emerging companies - proximity to a network of federal laboratories that fund basic research, generate research, and employ highly skilled scientists. Access to federal agencies such as the Food and Drug Administration, the NIH, the National Institute of Standards, and the United States Department of Agriculture-Beltsville, gives Maryland an increased competitive advantage.

Based on these favorable ingredients, the Sage Policy Group, in *Maryland: The Nation's Bioscience Leader*, concluded that the Maryland bioscience sector is among the nation's largest in terms of economic output.[9]

Maryland's Bioscience Companies

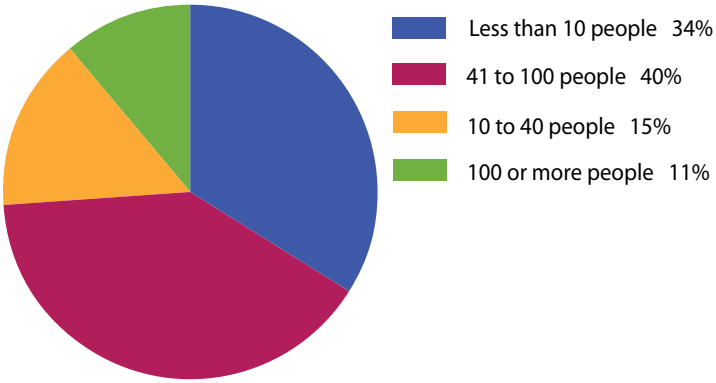
The Biosciences Industry Initiative Steering Committee also used the MdBio definition for bioscience to identify 419 private sector companies from information and corporate lists provided by the Maryland Department of Labor, Licensing and Regulation (DLLR); the Maryland Department of Economic Development (DBED); MdBio; and The Technology Council of Maryland. In addition, it identified 200 academic or public sector (federal, state, or local) organizations that correspond with the bioscience definition, or have a workforce whose skills are transferable to bioscience companies.

Table 1: Largest Bioscience Employers in Maryland

Company	Location	Company	Location
Actavis	Multiple	Life Technologies	Multiple
American Red Cross Holland Laboratory	Montgomery County	MacroGenics	Montgomery County
Baxter Healthcare Corp	Beltsville	Martek Biosciences	Howard
BD Diagnostics	Baltimore County	MedImmune	(Multiple Counties)
Bioqual	Montgomery County	MGIPharma,Inc/Eisai Corp.	Baltimore City
BioReliance	Montgomery County	Midwest Research Institute - National Capital Region	Rockville
BioVeris	Montgomery County	NABI Biopharmaceuticals	Rockville
Cambrex Bio Science Baltimore, Inc	Baltimore	NIRO Inc.	Columbia
Celera Geonomics	Montgomery County	Otsuka America Pharmaceutical	Montgomery County
Chesapeake Biological Laboratories	Baltimore City	Otsuka America Pharmaceutical Inc.	Rockville
Digene	Montgomery County	Otsuka Maryland Research Institite	Rockville
DynPort Vaccine Company	Frederick	Pharmaceutics International	Baltimore County
Fisher BioServices	Montgomery County	ProSpect Pharma	Howard
Gene Logic Inc.	Gaithersburg	Qiagen	Montgomery County
Human Genome Sciences	Montgomery County	SAIC Life Sciences Operation	Frederick
Intercell	Montgomery County	Shire US Manufacturing	Baltimore County
Intracel Resources	Frederick	Tishcon Corp.	Salisbury
J. Craig Venter Institute	Montgomery County	United BioSource	Montgomery County

Source: Maryland Department of Business and Economic Development and Bioscience Steering Committee.

Figure 2: Size of Bioscience Companies in Maryland



Source: MdBio, *Taking Care of Business, Bioscience in Maryland 2007*

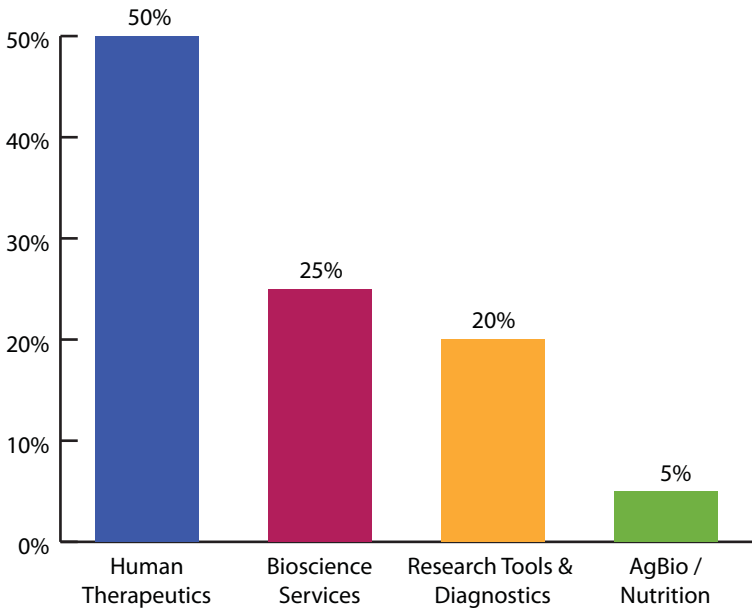
Maryland's companies tend to be small, homegrown and not yet profitable. Only one third of Maryland's bioscience companies are profitable, which is typical of an industry in which it takes from eight to 15 years to bring a product to market. Less than 11 percent have more than 100 employees. More than a third have ten or fewer employees and 29 percent have ten to twenty employees. Industry experts agree that the industry will likely grow not from an infusion of companies from other regions or countries, but from a steady stream of companies launched from Maryland's major research institutions and federal laboratories.

A Glimpse into Maryland's Bioscience Companies

Maryland's 419 bioscience companies work to cure diseases, detect and diagnose illnesses, expedite and improve medical treatment, clean the environment, feed livestock, and address the need for personalized medical care.

In 2006 almost half of Maryland's bioscience companies self reported that they were in the human therapeutics industry sector.[10] A company in the forefront of medical treatment is MedImmune, which was acquired by Astra Zeneca in 2007. MedImmune produces Synagis, a drug that helps keep premature babies from getting respiratory diseases. Synagis was the first monoclonal antibody successfully developed to combat an infectious disease – specifically respiratory syncytial virus. MedImmune is one of Maryland's giants and employs more than 1,000 people. An example of a smaller company is CSA Medical, Inc., developed a treatment for esophageal cancer that uses liquid nitrogen to cryogenically kill pre-cancerous and cancerous cells.

Figure 3: Bioscience Companies in Maryland, by Sector



Source: MdBio, *Taking Care of Business, Bioscience in Maryland 2007*

About 25 percent of the industry is in bioscience services. An example of a service company is Next Breath who helps improve medical treatment by measuring sprays for pharmaceutical and medical companies. This unique company measures the volume of spray, the rate of penetration, and the percentage of medication in sprays and inhalants. Another example is Sterilex Corporation who develops decontamination products that kill clumps of micro-organisms called biofilms (populations of microorganisms) that coat surfaces such as the outside of catheters or other tubes inserted into bodies. The plaque on your teeth is a biofilm. Removing biofilms can greatly reduce the risk of infection or decay.

About 20 percent of the industry is in research tools and diagnostics. Diagnostic companies include the 1,400 employees of BD Diagnostic Systems who develop and manufacture culture dishes and a range of medical diagnostic devices that can quickly and accurately identify a broad range of infectious diseases. Another diagnostics company, A&G Pharmaceuticals developed a biopsy staining kit that identifies breast cancer patients who will be resistant to certain treatments for the cancer. A&G also produces a blood test for routine screening for breast cancer that makes the cancer easier to detect in its earliest stages. Digene markets the only FDA-approved test for detection of human papillomavirus, the principal cause of cervical cancer, and Human Genome Sciences is developing drugs to treat Hepatitis C, lupus, anthrax, rheumatoid arthritis and HIV/AIDS.

> **"The environment inside a successful biotechnology company is characterized by high standards, intense and fast-paced activities, highly rewarding, science and technology applied on a large scale, highly regulated, 'high tech and high touch,' and 'team-based-everything."**
>
> *- California State University Program for Education and Research in Biotechnology*

Five percent of the industry is in agricultural bio or nutrition. Another company, Athena Environmental Sciences is the inventor of the bilge pill, a fast-acting, biodegradable, non-toxic cleansing agent that breaks down bilge petroleum build up in fresh or salt water. The bilge pill, about the size of a hockey puck, is put in

the bilge in a mesh bag, and the natural rocking motion of a boat causes the active agents to dissolve the bilge in about 60 days. Pharmacogenetics, Inc. is developing a biorefinery that will process tobacco and turn it into protein products or energy products.

Where are Maryland's Bioscience Firms Are Located?

Maryland's bioscience firms are clustered in several geographic areas, one of which is in the Montgomery County area near the NIH. Fully 55 percent of Maryland's bioscience companies are located in Montgomery County along the I-270 corridor. The region is home to MedImmune/AstraZeneca, Avalon Pharmaceuticals, and the Shady Grove Life Sciences Center, a 300-acre research park zoned exclusively for biosciences companies.

The Greater Baltimore region, where economic development officials and business leaders estimate there are about 80 bioscience companies, claims 23 percent of the industry. Greater Baltimore is also home to two bioscience parks, with a third under construction. When all three research parks are fully completed, the Greater Baltimore region will have three million square feet of bioscience facilities that are expected to generate almost 8,000 new jobs.[11] To the west, Frederick County has 15 percent, and other areas represent seven percent of the biosciences industry in Maryland.

Although the bioscience industry is regarded as regional, spanning from Baltimore County to Montgomery County, commuting between the two major clusters is difficult because of congested roadways. During morning and evening drive time, moving between Baltimore City or County and Montgomery County can take up to two hours, although the geographical distance is less than fifty miles.

Economic Impact of the Bioscience Industry in Maryland

The Sage Policy Group estimates that there are almost 30,000 employees in the private sector component of the industry, and an additional 30,000 researchers at related federal agencies, military institutions, and research universities.[12] The Sage Policy Group also estimates that in Maryland, 3.3 additional jobs are created for every bio/pharma job. The Maryland bioscience industry, private and public companies, therefore generate an additional 198,000 indirect jobs in other industry sectors from retail to IT.[13] The report also concludes that the sector generates $11 billion in income and $600 million in state government taxes annually.

Table 2: Estimates of Bioscience Revenues

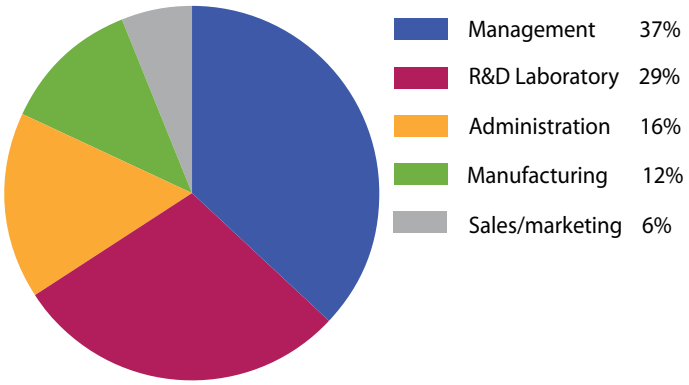
Industry - NAICS	Establishments	Receipts $0	Payroll/Year ($000)	Paid Employees	Revenue/ Job ($)
Maryland					
R&D in the life sciences-5417102	320	$2,065,602	$823,696	11,294	$182,894
R&D in biotechnology-54171023	147	$1,031,531	$466,213	5,337	$193,279
United States					
R&D in the life sciences-5417102	6,119	$26,316,797	$17,418,708	244,737	$107,531
R&D in biotechnology-54171023	2,676	$12,162,111	$9,613,005	121,931	$99,746

Note: This chart focuses on revenues for research and development firms. The North American Industry Classification System (NAICS) is an industrial classification system that groups establishments into industries based on the activities in which they are primarily engaged. Most reports on bioscience focus on manufacturing and research and development. Manufacturing of pharmaceuticals, medicines, and instruments is covered by NAICS 3254, 3345 and 3391. Research and development is covered by NAICS 5413, 5416 and 5417. A listing of the NAICS industries used by the Bioscience Industry Initiative Steering Committee can be found in Table 6.

Maryland's bioscience industry is comprised of 419 private businesses employing 27,000 workers - an increase of nearly 50 percent since 1998. (The Bioscience Industry Initiative Steering Committee's employment estimation method differs somehwat from the method used by Sage Policy Group.) The workforce draws not only from private companies and universities, but also from the large number of federal agencies and laboratories in the region, as well as area health care facilities.

A typical employee distribution is 37 percent in management; 29 percent in R&D; 12 percent in manufacturing; 16 percent in administration and clerical, and 6 percent in sales and marketing.[14]

Figure 4: Types of Jobs at Bioscience Companies in Maryland



Source: MdBio, *Taking Care of Business, Bioscience in Maryland 2007*

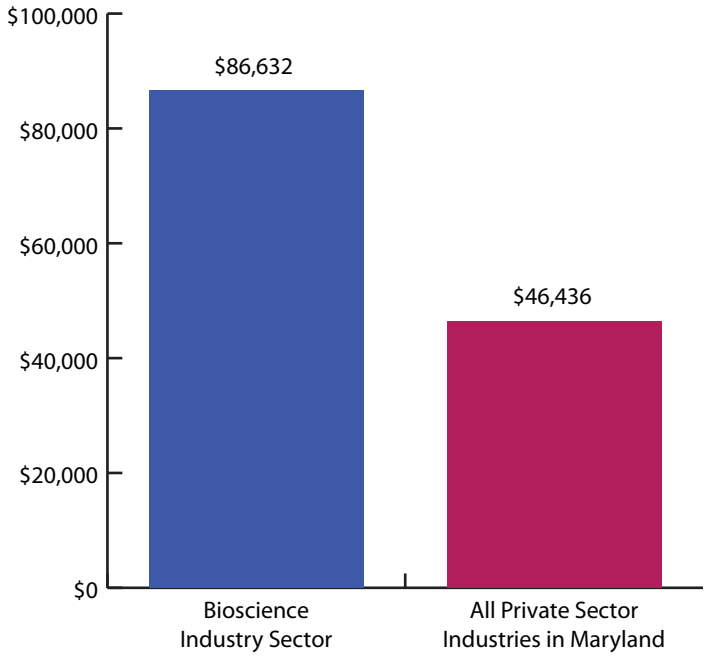
Wages, Gender, and Age

For 2007, the average annual wage of bioscience workers in Maryland was $86,632, which is 86 percent greater than the average annual wage for private sector workers in Maryland. On average, both male and female bioscience workers earned higher wages than their counterparts in the overall workforce.[15]

Maryland's bioscience industry employs a much higher proportion of men than women. The male to female ratio of 61:39 greatly deviates from the 50:50 ratio found across the totality of Maryland's industries.[16]

The age distribution of Maryland's bioscience workforce is similar to that of all industries in Maryland. Mirroring Maryland's overall workforce, the baby-boomers in the bioscience industry are approaching the traditional retirement age of 65, preceded by a smaller generation of workers.[17]

Figure 5: Average Annual Wages per Worker in Maryland 2007



Source: Maryland Department of Labor, Licensing

Compared with other industries in the state, the bioscience youth workforce (21 and under) is quite low versus the amount for all industries in the state. The low proportion of youth workers is consistent with the relatively high educational requirement of occupations in the bioscience industry.

> **While the skilled workers needed by the industry is skewed toward highly skilled well paying jobs, there is also a need for administrative workers, manufacturing personnel, lab technicians, stock clerks, and data entry personnel.**

Workforce Demand in Maryland

A look at national projections for job growth in the biosciences industry, and the salaries associated with the high growth occupations, is instructional. The Bureau of Labor and Statistics predicts employment among scientists is increasing three times faster than other occupations. Maryland's DLLR occupational projections for 2004 to 2014 show that science and engineering occupations, which are prevalent in the bioscience sector, are expected to grow at 1.5 times the rate of other occupations. Most companies are small, are in a start-up phase, and therefore employ highly skilled, highly educated workers. As these companies mature, their labor needs will change. Some companies will follow AstraZeneca's (MedImmune) and Martek's model, moving from basic research to applied research, testing and on to manufacturing. As a result, in each phase, these companies will need a larger workforce with a diverse set of skills.

At present, bioscience high demand occupations are concentrated in engineering and science, followed by occupations in manufacturing, legal, and quality assurance.

Table 3: High Demand Occupations in the Bioscience Sector

Major Category	Specific Occupation	Major Category	Specific Occupation
Executive Level	Top Clinical Research Executive	**Technical Skill Level**	Bio/Immuno Assay Development
	Top Experimental Medicine Executive		Microbiology/Bacteriology
	Top Clinical Safety and Drug Monitoring Executive		Biological Manufacturing-Pilot Plant
	Second Level Discovery Research Executive		Biological Process-Cell Culture
	Top Research and Development Executive		Clinical Research Monitoring (CRA)
Supervisory Level	Engineering and Sciences-Multiple Functions		Chemistry-Analytical
	Program Manager		Toxicology
Legal and Regulatory	Regulatory Affairs		Bioinformatics
	Regulatory Documentation		Clinical Supplies/Packaging
	Top Regulatory Affairs Executive		Molecular Discovery/Development
	Document Control-Regulatory		Chemistry
	Regulatory Approval Liaison		Clinical Research (Non M.D.)
Quality Assurance	Quality Control, In-Process and Release Control		Biostatistics
	Quality Assurance Documentation		Biology, Discovery
	Quality Control		Laboratory Animal Care
	Validation Analysis-Quality Process		Pharmaceutical Process Development
	Quality Assurance-Policy and Strategy		Clinical Research (M.D.)
Manufacturing	Top Manufacturing Executive		Animal Pathology (D.V.M.)
	Pharmaceutical Operator		
	Pharmaceutical/Biological Plant Management		
	Manufacturing-Generalist/Multiple Functions		

Source: Bioscience Industry Initiative Steering Committee

Workplace Competencies

Because the industry changes so rapidly, the average bioscience worker can expect five to seven career changes during his or her working lifetime. The pressure on workers to upgrade skills is, and will be, considerable.

Bioscience high demand occupations require technical and academic competencies related to science (biology, etc), technology, math, and engineering (STEM) disciplines. In a skills study conducted by the Biosciences Industry Initiative Steering Committee, industry participants expressed confidence that the STEM knowledge can be acquired from Maryland's community colleges and universities, with industry specific skills taught by individual companies. They noted that company expectations of future new and incumbent workers also included: knowledge of, and appreciation for, aspects of business development, impact and management, regulatory management, regulatory matters and FDA compliance, quality issues, Good Manufacturing Practices (GMP), technology management, project management, and data management, interdisciplinary aspects of product creation, and drug development and approval mechanics.

Workforce Essential Skills

Soft skills are equally, if not more important. "The environment inside a successful biotechnology company is characterized by high standards, intense and fast-paced activities, highly rewarding, science and technology applied on a large scale, highly regulated, 'high tech and high touch,' and 'team-based-everything."[18] In addition, employers will demand dependability, intense attention to detail, good reporting and data presentation skills, and the ability to work well with a broad spectrum of co-workers. Workers need to have the flexibility to change as the industry evolves and the desire to learn new skills constantly. Soft skills are the new "essential skills."

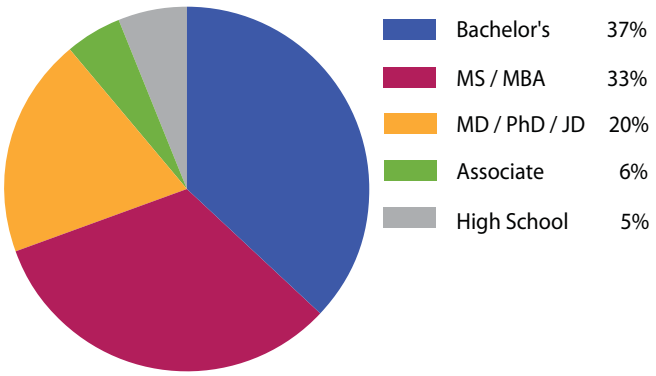
Bioscience Worker Education and Training in Maryland

Maryland offers a highly educated and highly skilled workforce to the industry. The state is ranked:

- 1st among all states (25.7) in percentage of professional and technical workers;
- 2nd in concentration of doctoral scientists and engineers, including first in health sciences and second in bio and agricultural sciences; and
- among the top states in percentage of population that holds a bachelor's degree or higher (35.1 percent).[19]

In 2004, there were more than 20 companies in Maryland conducting clinical trials and almost as many ready to enter clinical trials, driving the need to train workers in all aspects of biomanufacturing and pharmaceutical manufacturing. A parallel need has grown to encourage more students to enter the fields of science and engineering, and to ensure that those with backgrounds in basic science are more aware of the jobs available in the bioscience industry.

Figure 6: Degrees Held by Employees of Bioscience Companies in Maryland



Source: MdBio, *Taking Care of Business, Bioscience in Maryland 2007*

Higher education resources in this field include the eleven campuses of the University of Maryland System and the Johns Hopkins University, both known as centers of academic excellence in the health sciences, biotechnology, biomedical and chemical engineering, biological sciences, mathematical sciences and computer sciences. The University of Maryland Biological Institute is the only Maryland institution with a legislative mandate to drive economic development of biotechnology-related industries through research and educational training. Independent four-year colleges like Stevenson University and Hood College also offer

course work in the biosciences.

Table 4: Maryland 4-Year College and Universities' Biotechnology Programs

College or University	Degree Type	Program Name
Columbia Union College	Bachelor's	Biochemistry
Hood College	Bachelor's	Biochemistry
	Master's	Biomedical science
Johns Hopkins University	Bachelor's	Biomedical engineering, biophysics, cellular and molecular biology, and chemical & biomolecular engineering
	Master's	Applied biomedical, engineering, bioinformatics, bioscience regulatory affairs, biotechnology, cellular & molecular , and biology
	Doctorate	Biochemistry & cell, biology, biochemistry & molecular biology, biostatistics, genetics, molecular biology, and molecular microbiology & immunology
	Post-Baccalaureate Certificate	Biotechnology enterprise
Morgan State University	Master's	Bioinformatics
	Doctorate	Bio-environmental sciences
Mount Saint Mary's University	Bachelor's	Biochemistry
Saint Mary's College of Maryland	Bachelor's	Biochemisty
Stevenson University	Bachelor's	Biotechnology
Towson University	Bachelor's	Molecular biology, biochemistry, bioinformatics
University of Maryland University College	Bachelor's	Biotechnology (BTPS)
	Master's	Biotechnology studies
	Post-Baccalaureate Certificate	Bioinformatics and biotechnology management
	Upper Division Certificate	Bio-security
University of Maryland, Baltimore	Master's	Molecular and cell biology
	Doctorate	Molecular medicine
University of Maryland, Baltimore County	Bachelor's	Biochemistry & molecular biology and bioinfomatics & computational bio
	Master's	Applied molecular biology and chemical & biochemical engineering
	Doctorate	Biochemistry (w/UMAB) and molecular & cell biology
	Post-Baccalaureate Certificate	Biochemical regulatory engineering and biotechnology management
University of Maryland, College Park	Bachelor's	Biochemistry, bioengineering, and microbiology
	Doctorate	Biological resources engineering, cell biology & molecular genetics, and molecular & cell biology

Source: Maryland Higher Education Commission

Ten community colleges offer biotechnology programs and continuing education, and workforce training programs are available through all 16 of Maryland's community colleges. The Maryland Community Colleges Business Network can provide custom workforce training at an employer's site.

Table 5: Maryland Community Colleges' Biotechnology Programs

Community College	Degree Type	Program Name
Allegany College of Maryland	Lower Division Certificate	Medical Lab Technology-Biotechnology
Baltimore City Community College	Associate	Biotechnology
Community College of Baltimore County	Associate	Biotechnology
	Lower Division Certificate	Biotechnology
Frederick Community College	Associate	Bioprocessing Technology
	Lower Division Certificate	Bioprocessing Technology
Hagerstown Community College	Associate	Biotechnology
	Lower Division Certificate	Biotechnology
Harford Community College	Associate	Science Lab Tech
	Lower Division Certificate	Biomedical Engineering
Howard Community College	Associate	Biomedical Engineering
Montgomery College	Associate	Biotechnology
	Lower Division Certificate	Biotechnology

Source: Maryland Higher Education Commission

Biotechnology training is also available from private career schools, such as Medix School-South, and foundation/grant funded training programs from the BioTechnical Institute of Maryland. The Foundation for Advanced Education in the Sciences (FAES) Graduate School at NIH offers nearly 200 courses each year at both the graduate and undergraduate levels that are open to both government and non-government employees alike. The majority of the FAES Graduate School courses are in the biomedical field with other course selections focused on the physical and behavioral sciences, technology transfer and biotechnology laboratory programs. Unique to the region are the school's "Certificate in Technology Transfer" and the biotechnology lab "Bio-Trac" trainings.

Other training programs unique to Maryland include:

- University of Maryland Technology Enterprise Institute's Biotechnology Program;
- University of Maryland Bioprocess Scale-up Facility (BSF) offering small and large companies access to cost efficient scale-up and development of bioprocesses and products and specialized workforce training;
- The Institute for NanoBioTechnology at the Johns Hopkins University;
- Maryland Industrial Partnership Program (MIPS) to accelerate commercialization of technology by providing matching funds for collaborative R&D projects between companies and University of Maryland faculty;
- UMBI's Center for Advanced Research in Biotechnology, a center of excellence in protein structure and engineering and other molecular studies; and
- Biotechnical Institute of Maryland which takes unemployed and underemployed workers and trains them, tuition free, for jobs as lab technicians.

While the skilled workers needed by the industry is skewed toward highly skilled well paying jobs, there is also a need for administrative workers, manufacturing personnel, lab technicians, stock clerks, and data entry personnel. A 2007 report by the Jacob France Institute, *An Evaluation of Earnings and Workforce Development Impacts of the BioTechnical Institute of Maryland, Inc.*, indicates there are workforce shortages in the industry across all skill levels and positions, with a higher concentration at the lower levels. The Institute estimated that almost 38 percent of the jobs in Maryland's bioscience firms could be filled "with persons with less than an Associate's degree, presuming they have adequate training."[20]

Workforce Issues and Recommendations

The Bioscience Industry Initiative Steering Committee identified five issues that affect the industry's ability to attract, recruit, train and/or retain a highly skilled workforce. Committee discussion generated a wide range of possible actions and other strategies that both industry and the state might adopt to address these issues. These issues and suggested recommendations were presented at the *Bioscience Workforce Summit* in May 2008.

The issues, sorted by the committee in order of significance, are described in this section. The issues are:

1. Perception of Maryland
2. Employee Attraction, Recruitment and Retention
3. Education and Training
4. Quality of Life (affordable housing, transportation, tax burden)
5. Workforce Forecast

Issue 1: Perception of Maryland and Our Bioscience Industry

Individuals from other areas who are being recruited to Maryland companies have little knowledge of Maryland's industry base, the state's history, culture, recreations and amusements, or overall quality of life found in the state.

Discussions with industry recruiters suggest that potential workers in other states had no real perception of what life in Maryland might be like. Their reluctance to consider positions in the state was founded on a fear that there would not be quality schools, affordable housing, access to recreation, and ease of transportation. In short, they had no informed sense of the state.

There is a consensus about two major components of the perception issue. First, Maryland does not have a unified image or marketing effort. Recruiters talked about having to go to two or three web sites to cobble together the "life" information that candidates requested. Secondly, because there are several clusters of bioscience in Maryland, candidates did not get a sense that the state had a unified bioscience community. The Bioscience Industry Initiative Committee concluded that Maryland (government entities, trade associations) does not market the industry or the state well.

Recommendations:

- Identify existing marketing efforts and materials: consolidate and fill in gaps.
- Create a unified marketing plan for the state and for the bioscience industry in Maryland for both internal and external publics.

Update: Maryland Bio 2020 Initiative

The Bioscience Industry Initiative Steering Committee shared this and other report recommendations with the Life Sciences Advisory Board (LSAB) in the months leading up to the Bioscience Workforce Summit in May 2008. Many key elements of the Bio 2020 Initiative were based on recommendations from the LSAB, who developed statewide strategic plan for biosciences in Maryland.

In June 2008, Governor O'Malley announced the Maryland Bio 2020 Initiative under which the State of Maryland will invest $1.3 billion in Maryland's bioscience industry over the next 10 years - the largest per capita investment in the biosciences made by any state in the country - to attract and grow biotechnology companies in Maryland.
Key elements of the Maryland Bio 2020 Initiative include:

- The creation of the ***Maryland Biotechnology Center***
- Expanding and improving Maryland's ***Biotech Investment Tax Credit***
- Growing Maryland's ***Technology Incubator Network***
- Continuing to grow Maryland's nation-leading ***Stem Cell Research Fund***

Issue 2: Employee Attraction, Recruitment and Retention

The state and private industry must work cooperatively to institute programs and procedures that will attract and retain bioscience workforce talent.

The Committee recognized that Maryland is a hub of the largest bioscience sector in the country. Industry benefits from Maryland's concentration of science professionals, biotechnology firms, laboratories, research facilities and the state's outstanding education system. The Committee acknowledged that the bioscience industry's current technical workforce needs are being met by local talent and the industry's ability to recruit outside the state, including international students and science professionals. However, it was agreed that the industry needs to support programs and initiatives that ensure a future supply of talent for Maryland's biotechnology sector.

Recommendations:

- Support and increase programs like the Maryland Business Roundtable for Education, CTE programs, MdBioLab, UMBI's Loaner Lab, and J. Craig Venter's Discover Genomics!, and Mobile lab program.
- Build biotechnology career pathways for untapped diverse and non-traditional populations.
- Provide data that will attract emerging workers to the field of biotechnology, such as average salary.
- Address immigration issues such as difficulty in obtaining visas for foreign scientists and international students.
- Support initiatives for biomedical post-doctoral fellows at local federal labs to be recruited and retained for employment in local industry upon completion of their fellowships.
- Recruit retiring military talent currently working at military research facilities in Maryland.

Issue 3: Education and Training

The state and private industry must work cooperatively to align industry's knowledge and skill needs with the content and delivery of the education system.

Bioscience so rapidly evolves and changes that new and incumbent worker competencies quickly become obsolete. There is a concern how best to keep incumbent worker's skills current, as well as how educators and their programs can be kept up-to-date to benefit their students. In addition, while Maryland has an outstanding P-20 education system, like other states, there is desire to increase the number of students interested in science and other technology careers.

Recommendations:

- Establish an independent statewide bioscience board (commission, council, or alliance) to develop standards and other cooperative initiatives that align industry needs with the state's workforce development system.
- Develop a set of regionally defined bioscience industry skill standards to align workforce needs of the state's bioscience laboratories (industrial, governmental, and academic) with curriculum.
- Promote and support Maryland's STEM initiatives, including *Project Lead the Way Biomedical Sciences and Pre-Engineering Programs*, to produce an increasing and more diverse group of students to be successful in science, math, engineering and biotechnology.
- Supplement industry's in-house training (necessary for proprietary and very specialized job skills) with external "common needs" academic and technical skills training provided by Maryland's higher education system.
- Develop training and education programs that lead to "certification" of entry-level workers.

Issue 4: Quality of Life

Affordable Housing: *It is difficult for bioscience workers to find affordable housing near their place of employment.*

The major clusters of bioscience companies are in areas with shortages of affordable housing for entry-level workers. In Maryland, housing costs have escalated and family household income has not kept pace. Montgomery County, with the largest concentration of bioscience companies, has the largest shortage of affordable housing and available rental units. Not far behind are Baltimore County and City with significant numbers of bioscience companies. Baltimore City has two bioscience parks being built, one partially finished and Baltimore County has one bioscience park.

Recommendations:

- Support legislative efforts to increase development of workforce housing near areas of high bioscience density.
- Expand and modify the state's *Live Near Your Work* program which helps workers get housing within a reasonable distance of their job sites.

Transportation: *Because of the high price of housing in many bioscience markets, workers have to live far away from their jobs.*

Transportation continues to be a major economic issue for all of Maryland's industries. The 2006 American Community Survey shows that Maryland workers have an average commute time of 30.6 minutes, the second longest in the nation. 2000 Census data indicated that 40 percent of Maryland workers do not live in the county where they work. In interviews with recruiters, several noted that candidates expressed the concern that if they lived in the Baltimore region, they would not be able to get to work easily in the Montgomery County area and vice versa.

Recommendations:

- Conduct research on transportation and housing concerns.
- Examine mass transit solutions relative to the bioscience industry.

Individual Tax Burden: *Job candidates perceive Maryland to be a high tax state. This perception made candidates hesitant to take a job here. It is especially a problem for companies trying to attract top talent.*

For the most part, candidates focused on income tax rates to the exclusion of other individual taxes. Overall, the subcommittee found that Maryland compares favorably to many of the other major bioscience regions in the country which also tend to be located in states with relatively heavy tax burdens.

Issue 5: Workforce Forecast

Industry and its state partners need better workforce demand forecasts.

As noted in this report, bioscience is an emerging industry, characterized by entrepreneurial spirit in a fast, intense, and rapidly changing business environment. For most individual bioscience companies, it is a meaningless exercise to forecast their workforce needs more than three to five years into the future. Industry recognizes that without quantifying workforce demand, it is difficult to anticipate the types of education programs that will be needed to produce the workers of the future, and attract the number of students these programs need to serve.

With the current pace of change in both science and technology, it is imperative that local and state governments, in partnership with the bioscience industry and academia, constantly test and apply new approaches and solutions to understand what the bioscience workforce in Maryland might look like in ten to twenty years.

Recommendations:

- Create and refine biotechnology workforce data and forecasts.

Bioscience Workforce Development Plan of Action

After the May, 2008 *Bioscience Workforce Summit*, the Steering Committee reviewed the issues and recommendations. They defined four actionable goals based on the recommendations.

Goal: Establish a bioscience skills alliance task force board (commission, council, or alliance).

Action: *Develop a set of regionally defined bioscience industry skill standards to align workforce needs of the state's bioscience laboratories (industrial, governmental, and academic) with curriculum.*

Action: *Create active partnerships with industry and Maryland's higher education system to develop "common needs" academic and technical skills training to supplement industry's in-house training.*

Action: *Develop training and education programs that lead to "certification" of entry-level workers.*

Goal: Create a state-wide and unified marketing plan for bioscience with Maryland's Life Science Advisory Board.

Action: *Develop external marketing plan that promotes economic development and workforce attraction.*

Action: *Develop internal marketing plan to encourage more individuals to consider bioscience as a career.*

Goal: Create a bioscience workforce website.

Action: *Identify and link to existing bioscience education and training programs in Maryland.*

Action: *Create an on-line bioscience job/career exchange in partnership with DLLR.*

Action: *Build biotechnology career pathways for untapped and non-traditional populations.*

Action: *Create and refine biotechnology workforce data and forecasts, and provide data that will attract emerging workers to the field of biotechnology.*

Goal: Promote and support Maryland's STEM initiatives.

Action: *Facilitate the dissemination of best practices in STEM education.*

Action: *Provide official endorsement of STEM initiatives by state partners.*

The Bioscience Industry Initiative Steering Committee

The Governor's Workforce Investment Board (GWIB) organized the Bioscience Industry Initiative to analyze the sector's workforce demand and supply, and to develop strategies and policies that will assist the Governor, Maryland's workforce system and the bioscience industry to meet its workforce needs.

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The Bioscience Steering Committee (Continued)

The Governor's Workforce Investment Board (GWIB) organized the Bioscience Industry Initiative to analyze the sector's workforce demand and supply, and to develop strategies and policies that will assist the Governor, Maryland's workforce system and the bioscience industry to meet its workforce needs.

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Bioscience Industry Classifications

Table 6: Industries Used for Maryland's Bioscience Industry Initiative

Industry Name	North American Industry Classification System (NAICS)
Manufacturing	
Pharmaceutical and Medicine Manufacturing	3254
Analytical Laboratory Instrument Manufacturing	334516
Irradiation Apparatus Manufacturing	334517
Surgical Appliance and Supplies Manufacturing	339113
Professional, Scientific, and Technical Services	
Testing Laboratories	54138
Environmental Consulting Services	54162
Research and Development in the Physical, Engineering, and Life Sciences	54171

About the Governor's Workforce Investment Board

The Governor's Workforce Investment Board (GWIB) is the governor's chief policy-making body for workforce development. The GWIB is a business-led board of 45 members, a majority of whom represent the business community, as mandated by the Workforce Investment Act of 1998 (WIA). Other members include the governor and the lieutenant governor, cabinet secretaries, college presidents, the state superintendent of schools, elected officials, labor, and representatives of non-profit organizations. The GWIB is responsible for developing policies and strategies to form a coordinated workforce system from a variety of education, and employment and training programs. It brings together and focuses various workforce development partners and stakeholders on two key outcomes - a properly prepared workforce that meets the current and future demands of Maryland employers, and providing opportunities for all Marylanders to succeed in the 21st century workforce.

GWIB's Center for Industry Initiatives

The GWIB's Center for Industry Initiatives assesses the workforce issues and demands of Maryland's targeted industry sectors. Through the Center for Industry Initiatives, leaders from private industry, government, education and other stakeholders are engaged in a collaborative process which identifies critical industry workforce challenges and develops recommendations and strategies to address those challenges.

Mission

To guide a nationally-recognized workforce development system that aligns with the economic and educational goals of the State of Maryland and will result in a qualified workforce available to employers across the state.

Vision

A Maryland where every person maximizes his or her career potential and employers have access to the human resources they need to be successful. The vision includes:

- Alignment of the business, workforce system, and economic development interests in Maryland.
- Well-integrated, coordinated and collaborative systems across agencies, institutions, local municipalities, and business.
- Preservation and expansion of Maryland's highly-educated workforce.
- Creation of opportunities for all Maryland residents to participate and succeed in the workforce.

Goals

- Align the educational system (P through 20) with economic development and industry needs.
- Increase the supply of skilled and trained workers to address worker shortages.
- Enhance connections between the emerging workforce (youth) and the workplace.
- Provide opportunities for untapped workers (people with disabilities, ex-offenders, TANF recipients, immigrants, etc.) to realize their full potential.

Priorities for Education

- Develop a Science, Technology, Engineering and Math (STEM) agenda to prepare the emerging workforce for knowledge-based industries and occupations, and the influx of STEM-related jobs associated with Base Realignment and Closure (BRAC) actions.
- Expand Career and Technology Education (CTE) programs.
- Align adult learning efforts with existing workforce development programs.
- Increase faculty capacity in critical shortage areas (e.g., healthcare, education, STEM instruction, engineering, and BRAC-related occupations).
- Enhance opportunities for "early access" from high school to college.

Priorities for Workforce Creation

- Increase access to employment opportunities for historically untapped workers.
- Ensure a supply of well-prepared workers to address critical worker shortages.
- "Grow our own" skilled workers and link them with Maryland businesses.
- Create greater awareness and expand use of Maryland's One-Stop Workforce System with employers.

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The Governor's Workforce Investment Board is the Governor's chief policy-making body for workforce development.

Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor

Thomas E. Perez, Secretary
William G. Robertson, Chair
Eric M. Seleznow, Executive Director

Department of Labor, Licensing, and Regulation