LIFE SCIENCES MARYLAND

Jobs Analysis & Economic Impact Report 2011 • Jobs Analysis & Economic Impact Report 2011 • Jobs Analysis & Economic Impact Report 2011

A Maryland Department of Business & Economic Development Research Report

Measuring the job growth fueled by life sciences research and development in private, federal and academic facilities in Maryland between 2002-2010

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Life Sciences Maryland: Jobs Analysis & Economic Impact Report

Abstract

Life Sciences Maryland is a jobs analysis and economic impact study conducted by the Maryland Department of Business & Economic Development (DBED) to estimate the employment and economic impact of life sciences activity within the state. DBED applies a three-pronged approach to define life sciences activity within the state in order to capture the three major categories of Maryland life sciences activity: private sector life sciences, federal life sciences and academic life sciences.

According to the DBED analysis, Maryland life sciences directly accounted for 71,618 Maryland jobs in 2010. These consisted of 33,602 private sector nonacademic jobs, 29,777 federal non-academic jobs and 8,240 jobs in academic institutions. The life sciences directly accounted for $6.5 billion in aggregate wages and salaries in 2010. These include $3.0 billion in private life sciences wages and salaries, $2.8 billion in federal government wages and salaries and $693 million in academic wages and salaries. The overall impact of life sciences, including secondary impacts, is estimated at 160,030 jobs and $9.6 billion in salaries and wages.

Key Findings

- Maryland's life sciences leadership is the result of preeminent research by its private companies, federal facilities and academia institutions. The number of principal organizations conducting industry research and testing include:
  - 500+ Private Companies
  - 15 Federal Facilities
  - 16 Universities & Colleges
- Maryland leads the nation in university conducted life sciences research per capita
- The life sciences sector accounted for one-third of all job gains during 2002 to 2010Between 2002 and 2010, private life sciences salaries grew almost 50% from $60,906 to $91,034
- 94% of all private life sciences jobs are in two areas: Research, Testing & Medical Labs (74%); and, Drugs & Pharmaceuticals (20%)
- Health & Human Services is the largest federal life sciences employer in Maryland with 22,840 of the 29,777 federal jobs
- 96% of all federal life sciences jobs (28,591) in Maryland are in the Capital Region (Frederick, Montgomery and Prince George's counties)
- The Capital Region has the highest concentration of private (15,832) and federal (28,591) life sciences jobs; the Baltimore Region second largest cluster of private (13,994) and federal (1,186) jobs in the state

Direct Impacts

- Over 1,700 private sector establishments are directly involved in life sciences work - 5th highest concentration in the U.S.
- Life sciences directly accounts for 71,600 jobs—3% of all jobs in Maryland
  - 33,600 Private
  - 29,800 Federal
  - 8,250 Academic

- Maryland life sciences direct salaries total $6.5 billion
- Average life sciences salary across sectors is $91,100, 76% higher than the state's average
- 6% of Maryland's GDP—$17.6 billion—is generated by the life sciences

Secondary Impacts

- Including direct, indirect and induced jobs, the life sciences support 160,030 jobs—6.5% of the state's total—and equivalent to $9.6 billion in salaries
- Life sciences activity support nearly $500 million in annual income and sales taxes

Life Sciences Maryland: Jobs Analysis & Economic Impact Report

Introduction

Maryland's leadership position in life sciences research is driven by the research conducted in its world class federal, academic and private industry facilities. Maryland has been a national leader since the earliest days of the life sciences field due to the state's perennial leading position in research and development. The life sciences are a significant part of the $14 billion in total research and development conducted in the state.

This report focuses on three life sciences activity categories, each with significant impact: private industry activities, research and support activities at government facilities and university-based research and development.[1] Quantifying the impact of the life sciences in Maryland is both enriched and complicated by the contribution of each of these categories. Standardized definitions using industry classifications are necessary to enable comparisons to other states.

The approach used in this report allows us to estimate the overall economic impact of the state's life science sector. Using this approach and applying the latest available data, we estimate that Maryland life sciences directly accounted for 73, 633 Maryland jobs in 2010. These consisted of 33,602 private sector non-academic jobs, 29,777 federal non-academic jobs and 8,240 jobs at academic institutions.

Table 1

Maryland Life Sciences Jobs, Wages and Salaries and Facilities				
Category	**Direct Jobs**	**Total Wages & Salaries**	**Average Annual Salary per Job**	**Number of Facilities**
Private Sector	33,602	$3.1 billion	$91,034	1,752
Federal Government	*29,777*	$2.8 billion	$93,118	15
Academic	8,240	$692.7 million	$84,074	12-16
Total	71,618	$6.5 billion	$91,100	1,781

Source: DBED analysis of data from the Maryland Department of Labor, Licensing and Regulation

These life sciences jobs in Maryland directly accounted for $6.5 billion in aggregate wages and salaries in 2010. These include $3.1 billion in private life sciences wages and salaries, $2.8 billion in federal government wages and salaries and $693 million in academic wages and salaries.

In order to find the overall economic impact of Maryland's life sciences sector in Maryland, we also estimated the secondary economic impacts resulting from the life sciences activity. Secondary effects can include jobs supported at firms that are not directly considered life sciences firms, but which furnish key supplies or services enabling life sciences facilities to operate. They could also include jobs at companies that make consumer products whose demand is supported by life sciences wages and salaries. The overall economic impact is the sum of the scale of life sciences activity and its secondary effects. Including all secondary impacts, Maryland life sciences supported an estimated 160,030 jobs and $9.6 billion in wages and salaries (Table 2). The total job impact represents 6.5% of all Maryland jobs and 7.6% of all Maryland wages.

[1] Although the three categories are distinct, they often collaborate. Moreover personnel working in one group often switch jobs to work within another group, while remaining in life sciences. While fully recognizing this, this report assumes, for analytical purposes, that these three groups are mutually exclusive.

Table 2

Total Impact of Maryland Life Sciences Activity 2010				
Quantity	Direct	Secondary Effects		Total
		Indirect	Induced	
Jobs	71,618	28,246	60,166	160,030
State Gross Domestic Product	$17.6 billion	$7.2 billion	$12.2 billion	$37.1 billion
Wages & Salaries	$6.5 billion	$1.2 billion	$1.9 billion	$9.6 billion
Annual Average Salary per Job	$91,100	$41,589	$31,788	$60,062

Source: DBED calculations using publicly available data and the IMPLAN® Regional Economic Model for Maryland.

Definitions & Methodology

Life sciences can be described as the discovery and development of knowledge regarding life—whether microbial, plant, animal or human—and how it can be applied to achieve desirable purposes. These purposes can range from the improvement of human or animal health to the protection of the environment. The interdisciplinary nature of life sciences discovery requires diverse technologies to support this development pipeline, such as molecular biology, nanotechnology, bioengineering and software development. Information technology is a particularly critical tool for the analysis of unprecedented volumes of data generated by such sources as high throughput screening, genomic sequencing and population studies and others.

Unfortunately there is no universally accepted definition of "life sciences" activity useful for measuring life sciences activity either at the Maryland or national level. In order to analyze life sciences' role in the Maryland economy, we sought to create a definition for life sciences that spans the breadth of life sciences research, development, support. Our definition also had to recognize the broadly recognized principle that life sciences activity is not defined or distinguished necessarily by the products or services it creates. Instead, the life sciences are better characterized by the application and development of knowledge regarding the functioning of living things, such as plants, people or animals.

In this report Maryland private sector life sciences is defined as life sciences activity at establishments or facilities located in Maryland, owned by a non-academic private firm or organization, and based on standard industry categories to reflect core life science activities as outlined in Table 3.

DBED based its definition of private sector life sciences activity on one presented by Battelle Technology Partnership Practice.[2] As detailed in the Appendix to this report, we selected the Battelle approach as a starting point because it struck an appropriate balance between the overly broad definitions used by some life sciences authors, and the relatively narrow approach employed by others. The Bureau of Labor Statistics (BLS) categorizes U.S. nonfarm payroll jobs using a hierarchical system called North American Industrial Classification System (NAICS). This system allows BLS to assign every job type a six-digit NAICS identifier. The definition of private sector life sciences described in Table 3 builds on those six-digit NAICS codes in order to construct a life sciences definition of four sub-groups: agricultural feedstock and chemicals, drugs and pharmaceuticals, medical devices and equipment and research, testing and medical laboratories.

[2] Adapted from Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*. Biotechnology Industry Organization, http://www.bio.org/local/battelle2010/Battelle_Report_2010.pdf, p. 15-16.

Table 3

Private Sector Life Sciences Activity Definition Used in This Report	
NAICS	**NAICS Industry Title**
Agricultural Feedstock and Chemicals	
325199	All Other Basic Organic Chemical Manufacturing
325221	Cellulosic Organic Fiber Manufacturing
325311	Nitrogenous Fertilizer Manufacturing
325314	Fertilizer (Mixing Only) Manufacturing
325320	Pesticide and Other Agricultural Chemical Manufacturing
Drugs and Pharmaceuticals	
325411	Medicinal and Botanical Manufacturing
325412	Pharmaceutical Preparation Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
Medical Devices and Equipment	
333298	All Other Industrial Machinery Manufacturing
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334516	Analytical Laboratory Instrument Manufacturing
334517	Irradiation Apparatus Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing
Research, Testing and Medical Laboratories	
541380*	Testing Laboratories
541690	Other Scientific and Technical Consulting Services
541711	Research and Development in Biotechnology
541712*	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
621511	Medical Laboratories
621512	Diagnostic Imaging Centers

* Many facilities/establishments associated with these two NAICS industries are not actually engaged in life sciences activity. DBED identified the appropriate portion to include using methods described in the Appendix.

We applied the definition to the Maryland 2010 BLS Quarterly Census of Employment and Wages database. This database contains a highly accurate "near census" count of quarterly aggregate wages and monthly employment by county, state and NAICS code.[3] We also used data from the 2007 Economic Census. This process allowed us to estimate private life sciences jobs and wages.

Along with private sector life sciences, we also wanted to recognize the uniquely significant share of Maryland life sciences activity taking place at Maryland-sited federal research laboratories and at Maryland-sited academic institutions, both public and private.

Federal life sciences is defined as activity occurring at Maryland federal centers for research and development or life sciences support. We identified 15 such facilities, mostly research laboratories. We then applied publicly available information to estimate the number of directly employed federal

[3] The Quarterly Census of Employment and Wages Program is a cooperative program involving the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor and the State Employment Security Agencies (SESAs). http://www.bls.gov/cew/cewover.htm.

employees at each site. This allowed us to ensure federal contractors were not included in our estimates. We arrived at a total of 29,777 jobs at those facilities.

Academic research is the third component of the DBED life sciences definition. Academic life sciences is defined as Maryland-based scientific activity meeting the National Science Foundation's (NSF) criteria for academic life sciences research and development.[4] There is no official count of academic life sciences research and support jobs. Therefore we estimated these jobs and associated wages by applying 2009 NSF spending data on life sciences academic research and development to QCEW data, the May 2010 Occupational Employment and Wages Statistics and the proprietary IMPLAN® Regional Economic Model for Maryland.

DBED applied the above definitions to estimate directly employed Maryland life sciences jobs and annual salaries. The overall economic impact includes the indirect and induced, or secondary effects. Secondary effects encompass jobs at Maryland firms not considered life sciences firms, but which enable life sciences facilities to operate by supplying key supplies and/or services. These effects also include jobs supported by the local spending of Maryland residents that work in life science. DBED estimated the secondary effects by applying the direct effect to the Maryland IMPLAN® model.

[4] National Science Foundation, National Center for Science and Engineering Statistics (NCSES).

Life Sciences in Maryland

Private Sector Life Sciences

DBED estimates that approximately 500 "core" life sciences companies operate in Maryland[5], engaging in such diverse activities as biopharmaceutical discovery, research tools development, medical diagnostics device development, contract research, manufacturing operations and others. These 500 companies are part of a broader network of 1,700 establishments, including multiple facilities of medical labs, diagnostics and testing companies, specialized service providers, consulting services and firms supplying bio equipment in response to Maryland and out-of-state demand. These 1,700 private life sciences facilities account for 33,602 jobs and $3.1 billion in wages and salaries, yielding an average annual salary of $91,034 per Maryland life sciences job.

The majority of private life sciences companies are dedicated to the development of life-savings drugs, diagnostics and devices. A significant number of companies provide the fundamental tools needed to support life sciences research for molecular biology, including both specialized reagents as well as instrumentation. Contract research organizations (CROs) offer services for the biotechnology companies that then require clinical trial design and execution, data analysis, and regulatory support for FDA, USDA, or other approvals.

Yet private life sciences is a relatively small share of Maryland's broader economy. Table 4 shows that private life sciences accounts for 1.7% of the state's total private jobs in 2010. Moreover private life sciences accounts for 3.1% of Maryland total private wages and salaries in 2010.

Table 4

Maryland Private Life Sciences and the Broader State Economy 2010				
Job Category	**Jobs**	**Annual Wages & Salaries**	**Facilities/ Establishments**	**Average Annual Salary**
Maryland private life sciences	33,602	$3.1 billion	1,752	$91,034
Maryland total private nonfarm payroll	1,968,601	$97.5 billion	160,360	$49,504
Maryland private life sciences share of total private payroll	1.7%	3.1%	1.1%	183.9%

Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation

As seen in Table 5, Maryland's concentration of private life sciences employment is the 9th largest in the country, with a 30% higher concentration of life science employees than the U.S. Maryland's concentration of private life sciences establishments is the 5th largest in the country, with a 20% higher concentration of life sciences establishments than the U.S. Looking at both establishments and employment, the top states for life sciences are Massachusetts, California, New Jersey, Utah and Minnesota. In some states, this concentration is focused in a particular segment of the industry. Minnesota life science employment, for example, is concentrated in medical devices while New Jersey's is mostly in drugs and pharmaceuticals.

[5] Maryland Biodirectory, Maryland Biotechnology Center.

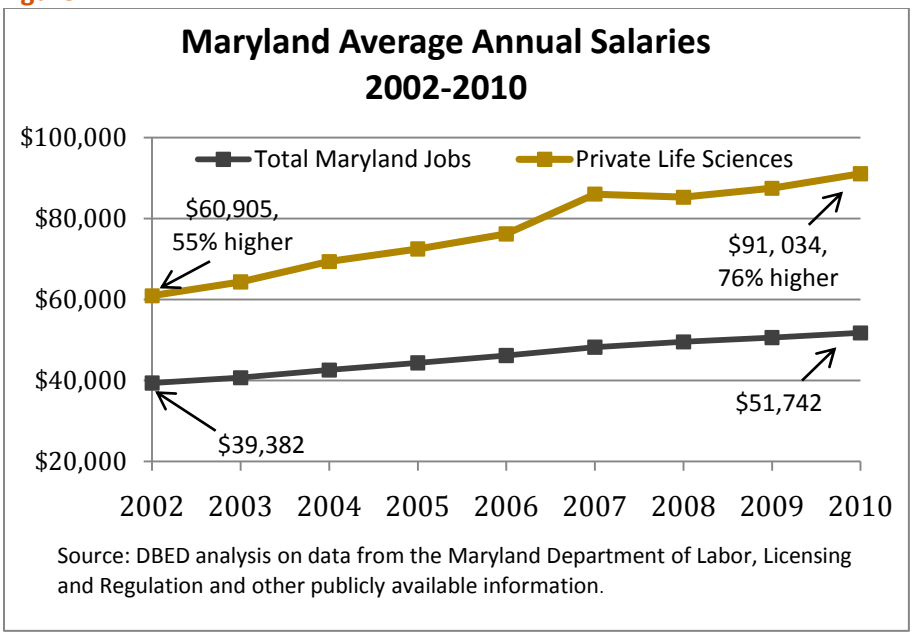
Table 5

Private Life Sciences Concentrations in Leading States					
Leading States by Establishments	**% Share of Private Establishments**	**Location Quotient**	**Leading States by Jobs**	**% Share of Private Jobs**	**Location Quotient**
California	1.7%	1.7	New Jersey	2.7%	2.1
Wyoming	1.5%	0.9	Massachusetts	2.7%	2.1
Louisiana	1.3%	0.9	Indiana	2.1%	1.7
Massachusetts	1.3%	1.7	California	2.1%	1.7
Maryland	**1.2%**	**1.2**	Utah	2.0%	1.6
Colorado	1.1%	1.0	Minnesota	1.8%	1.5
Florida	1.1%	0.9	Connecticut	1.7%	1.4
Oregon	1.1%	0.8	North Carolina	1.7%	1.4
Montana	1.1%	0.7	**Maryland**	**1.7%**	**1.3**
Nevada	1.1%	0.7	Pennsylvania	1.6%	1.3
U.S.	**0.9%**	**1.0**	**U.S.**	**1.3%**	**1.0**

Although private life science accounts for a relatively small share of Maryland jobs, other criteria highlight its importance. Among industrial sectors, private life sciences workers have consistently enjoyed annual salaries significantly higher than the state average in recent years (see Figure 1).

Moreover this advantage has grown. In 2002 private life sciences salaries averaged about 55% higher than the statewide average. By 2010, those salaries were $91,034 or 76% higher than the statewide average of $51,742. The state's private life sciences salaries have grown rapidly compared to national private life sciences as well. Figure 2 shows the state's private life sciences salaries jumping from near parity in 2002 to 7% higher than the nation's by 2009.

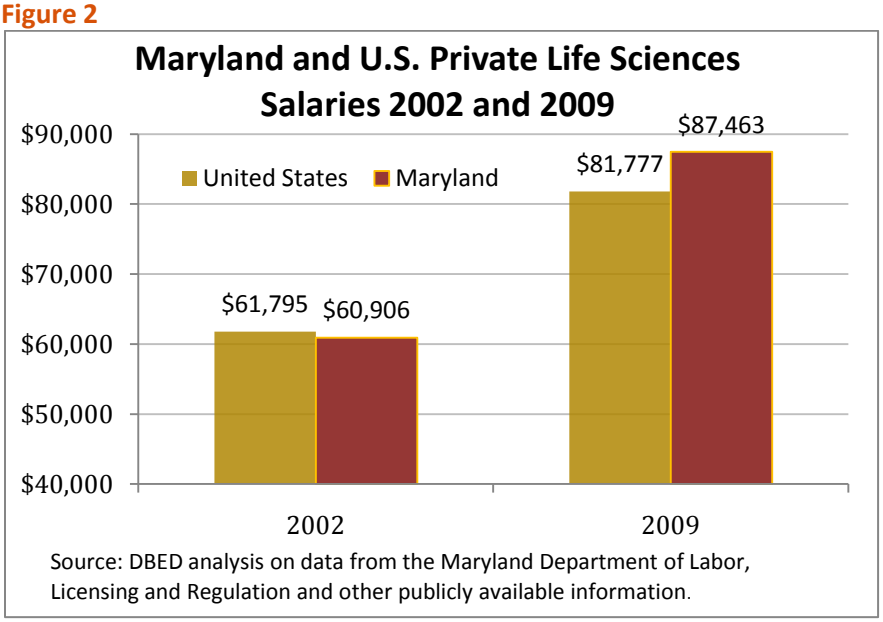
Figure 1



Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation and other publicly available information.

Maryland private life sciences salaries are 76% higher than the statewide average salary in 2010

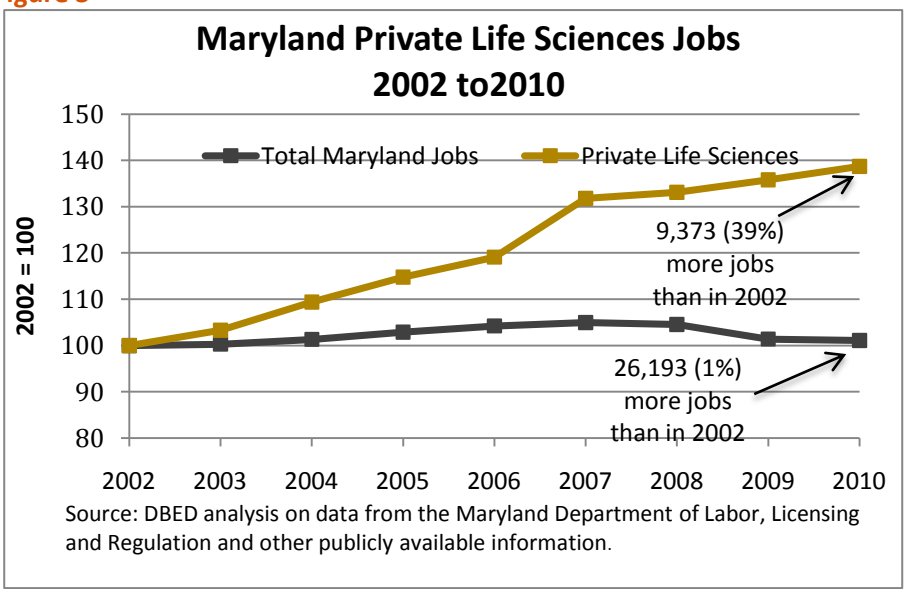
Figure 2



Maryland private life sciences salaries increased faster than U.S. private life sciences salaries 2002-2009 (44% vs. 32%)

Moreover the life sciences sector has been a principal driver of state job growth in recent years. This has been true both before and after the 2007-2009 recession. Figure 3 shows that Maryland private life sciences employment stood 39% higher in 2010 than in 2002. During this same period, statewide jobs levels remained level. Remarkably the life sciences sector accounted for over 35% of all of Maryland's job gains during 2002-2010. It did this, despite accounting for a mere 1% of all Maryland nonfarm payroll jobs in 2002.

Figure 3



Maryland private life sciences jobs increased nearly 40% from 2002-2010

Maryland private life sciences job growth also stands out compared to national private life sciences. During 2002-2009 Maryland private life sciences added jobs at almost twice the national rate; that is 39% growth compared to 20% growth nationwide.

Maryland Private Life Sciences by Sub-Group

Following Battelle, DBED examined Maryland private life sciences facilities by four sub-groups according to the general characteristics of the goods or services that the facility is engaged in producing[6].

• Agricultural Feedstock & Chemicals	Agricultural production and processing, organic chemical, fertilizer and biofuels manufacturing
• Drugs & Pharmaceuticals	Production of biological and medicinal products and the manufacture of pharmaceuticals and diagnostic substances
• Medical Devices and Equipment	Development and manufacture of surgical/medical instruments and supplies, laboratory equipment, electromedical apparatus, including MRI and ultrasound equipment
• Research, Testing and Medical Laboratories	Biotechnology and life sciences research and development, life sciences testing laboratories, stand-alone medical laboratories and other diagnostic centers

Table 6 shows Maryland private life sciences activity by sub-group in 2010. Research, testing and medical laboratories accounted for roughly three-quarters of private life sciences jobs. Drugs and pharmaceuticals accounted for another 20%. All four sub-groups support higher average salaries than the state as a whole. Drugs and pharmaceuticals salaries are the highest, averaging roughly twice the statewide salary. Research, testing and medical laboratories salaries are roughly 75% higher than the state average. The agricultural feedstock and chemicals sub-group has the lowest advantage, with 2010 salaries about 25% higher than Maryland statewide average.

Average jobs per facility ranges between 10 and 20 in three of the sub-groups. However this average is around 100 in drugs and pharmaceuticals, reflecting the presence of several major companies in Maryland, such as MedImmune with over 2,000 employees, BD Diagnostics with 1,600 employees and QIAGEN with 700 employees.

Table 6

Maryland Private Life Sciences by Sub-group 2010

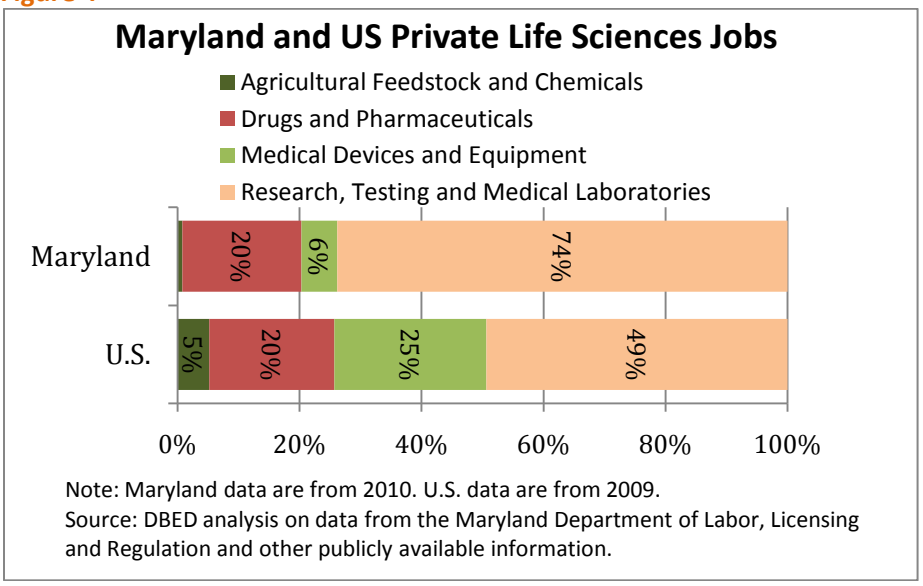
Sub-group	Employment		Average Annual Salary	Facilities	Average Jobs per Facility
	Jobs	Share			
Agricultural Feedstock and Chemicals	256	0.8%	$63,780	22	12
Drugs and Pharmaceuticals	6,574	19.6%	$102,084	65	101
Medical Devices and Equipment	1,962	5.8%	$67,612	86	23
Research, Testing and Medical Laboratories	24,810	73.8%	$90,239	1,579	16
Private Life Sciences Total	33,602	--	$91,034	1,752	19

Note: Components may not sum to totals due to rounding.
Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation

Figure 4 compares the distribution of Maryland life sciences jobs across sub-groups to the United States distribution. Compared to the U.S., Maryland private life sciences jobs are more highly concentrated in research, testing and medical laboratories. Nearly three-quarters of private Maryland life sciences jobs are in this sub-group, compared to roughly half of U.S. life sciences jobs. National life sciences employment is much more highly concentrated in medical devices and equipment and agricultural feedstock and chemicals than in Maryland. Both in Maryland and nationwide, roughly 20% of private life sciences jobs are in drugs and pharmaceuticals.

[6] Adapted from Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*, page *i*.

Figure 4

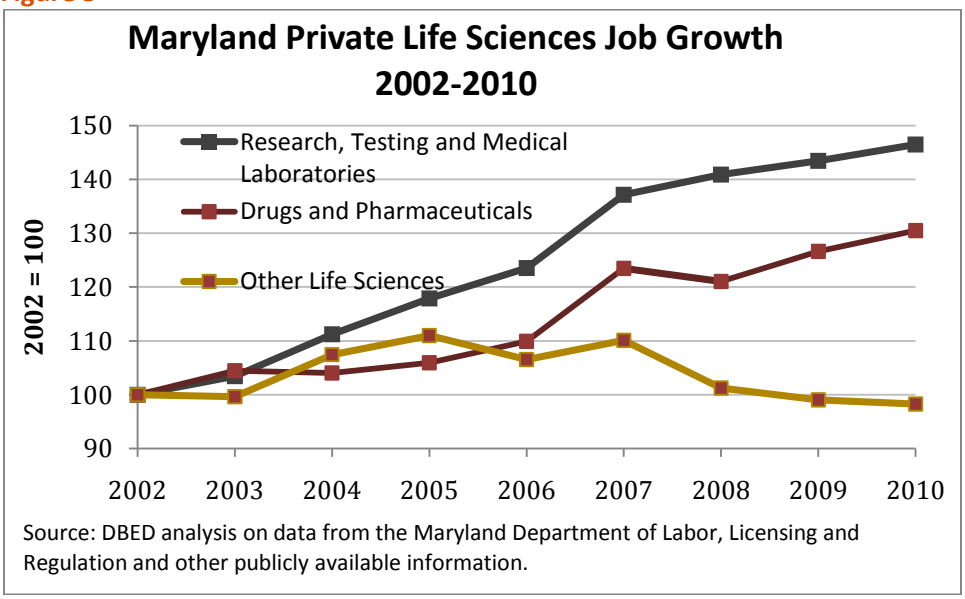


Note: Maryland data are from 2010. U.S. data are from 2009.
Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation and other publicly available information.

Research & development accounts for a high share of Maryland private life sciences jobs

Among the four sub-groups, research, testing and medical laboratories has added the most jobs. During 2002-2010 this sub-group alone added 47% of all private life sciences jobs, raising its share of private life sciences jobs from 70% in 2002 to 74% in 2010 (Figure 5). More than one job in five added in private life sciences was in research, testing and medical laboratories.

Figure 5



Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation and other publicly available information.

Maryland's private life sciences job growth from 2002-2010 was driven by research and testing

Regional Distribution of Private Life Sciences across the State

Table 7 displays how the state's private life sciences jobs are distributed geographically. The Baltimore and Capital Regions together account for nearly 9 out of 10 jobs in private life sciences. These two regions also accounted for the highest average life sciences salaries.

Table 7

Maryland Private Life Sciences Jobs by Geography 2010		
Region	Employment	
	Jobs	Share
Baltimore Region	13,994	41.6%
Capital Region	15,832	47.1%
Eastern Shore	1,565	4.7%
All other	2,210	6.5%
Private Life Sciences Total	33,602	100.0%

Notes: Components may not sum to totals due to rounding.
Source: DBED analysis of data from the Maryland Department of Labor, Licensing and Regulation

Table 8 displays private life sciences jobs in each region as a share of total employment. This table also reveals the regions with the highest relative concentration of private life sciences jobs. Nearly 2% of all Capital Region jobs are private life sciences jobs—the highest share in the state by a significant margin. This high share helps explain why this region has accumulated nearly half of Maryland's private life sciences jobs despite accounting for only about a third of the state's total jobs.

Table 8

Regional Life Sciences Jobs 2010			
Region	Private Life Sciences Jobs	Total Jobs	Private Life Sciences Share of Total
Baltimore Region	13,994	1,199,768	1.2%
Capital Region	15,832	837,571	1.9%
Eastern Shore	1,565	159,875	1.0%
All other	2,210	256,236	0.9%
Maryland Total	33,602	2,453,450	1.4%

Notes: Components may not sum to totals due to rounding.
Source: DBED analysis of data from the Maryland Department of Labor, Licensing and Regulation

Federal Life Sciences Research and Support

The federal government plays several important roles in promoting and supporting national life sciences activity. The government is a major source of funding for life sciences research and development, principally through the National Institutes of Health (NIH). It also provides critical support for private sector life sciences. For example, the Food and Drug Administration (FDA) supports the federal drug approval process allowing private pharmaceutical manufacturers to bring new drugs to market.

There are nearly 30,000 jobs at federal facilities in Maryland devoted to life sciences research and support activities

Compared to other states, federal life sciences activities exert both a significant and disproportionate impact upon Maryland. This is first because of the high number of federal life sciences jobs in the state, which drives up the significance of direct federal life sciences activity. In addition Maryland's higher concentration of private life sciences jobs makes Maryland a disproportionate beneficiary of federal life sciences research and market support efforts. Finally Maryland's relatively high concentration of life sciences academic research assets makes the state a disproportionate beneficiary of federal academic life sciences funding programs. Federal grants and procurement for life science activities represented over $1.5 billion in Maryland in FY 2010.

Moreover the federal government's own laboratories conduct much of the nation's most significant life sciences research, while administering programs that furnish additional training and experience to young researchers. Federal labs also actively promote the transfer of technologies they have developed or goods they have invented to the broader economy. These transfers encourage economic growth and support further research and development by both private and academic research organizations.

DBED estimates that the federal life sciences category—including laboratories and support and oversight facilities—account for 29,777 Maryland life sciences jobs with an average annual salary of $93,118. The Maryland federal life sciences facilities are listed in Table 9. The largest is the National Institutes of Health (NIH) headquarters and main campus in Bethesda, with 14,261 jobs or 48% of Maryland federal life sciences jobs. The second largest is the FDA headquarters in Silver Spring, with 5,745 jobs.

The agency or department accounting for the most jobs was NIH, whose five facilities accounted for an estimated 16,397 or 55% of federal life sciences jobs. The FDA's Silver Spring facility accounts for 19% of the state's federal life sciences jobs. The Department of Defense accounted for the third most jobs with 4,614 jobs or 15% of the total.

Table 9

Maryland Federal Life Sciences Research & Support Facilities	
Agency/Facility Name	**Jobs**
Department of Defense	
Aberdeen Proving Ground - Edgewood Campus*	550
Fort Detrick - Army Medical Research and Materiel Command	3,199
Walter Reed Army Medical Center Forest Glen Annex	865
U.S. Department of Health and Human Services	
National Institutes of Health (NIH)	
NIH main campus	14,261
National Cancer Institute, Rockville	250
National Cancer Institute at Frederick	1,000
Biomedical Research Center at Bayview	636
National Cancer Institute - Center for Cancer Research (CCR)	250
Center for Food Safety and Applied Nutrition	698
Food and Drug Administration	5,745
U.S. Department of Agriculture	
Foreign Disease-Weed Science Research Unit (FDWSRU)	53
Henry A. Wallace Beltsville Agricultural Research Center (BARC)	1,700
Animal and Plant Health Inspection Service (APHIS)	150
Other	
National Institute of Standards and Technology*	270
National Biodefense Analysis and Countermeasures Center	150
Total	29,777

** Jobs listed represent DBED's estimate for employment accounted for by life sciences.*
Source: DBED

Other Impacts of Federal Life Sciences Support on Maryland

The scope of this report limits its analysis of the economic and employment impact of Maryland life sciences to its impact on the state of Maryland. However the purpose of most significant federal life sciences activity is to increase the volume and value of discovery across the nation. To this end, the federal government performs much significant research in its own facilities. These efforts have led to the discovery and development of inventions and technologies whose value one can measure indirectly through overall licensing and other dissemination efforts. In FY 2009, the latest year available, the nation's federal research laboratories accounted for 10,913 active licenses for inventions or other intellectual property created at those laboratories. This level represents a 14% increase over the FY 2005 level and a 4% increase over the average of the previous three years. Collectively these licenses accounted for $154.3 million in revenue, a roughly 7% increase over the FY 2005 and about the same as the average over the previous three years.[7]

The Department of Health and Human Services, whose research assets account for the biggest federal life sciences footprint in Maryland, annually accounts for about 55% of all federal research laboratories'

[7] National Institute of Standards and Technology. *Federal Laboratory Technology Transfer Fiscal Year 2009: Summary Report to the President and the Congress*, http://www.nist.gov/tpo/publications/upload/Federal-Lab-TT-Report-FY2009.pdf, p. 9-17.

licensing revenue. Available data do not indicate the share of this revenue accounted for by federal research efforts sited in Maryland. However the agency's largest and third largest life sciences research branches—NIH and FDA respectively—are based in the state. So it is likely that Maryland-sited facilities figured prominently in this stream of innovation.

Federal funding for extramural life sciences research (research sited outside of federal research facilities), is another major federal policy that sustains life sciences activity. NIH funding supports a significant share of academic life sciences research. It also funds research at medical research institutions, hospitals and other organizations lacking academic affiliations. NIH funding of extramural research reached $25.8 billion in FY 2009, supplemented by an additional $4.4 billion appropriation directed by the American Reinvestment and Recovery Act of 2009 (ARRA). The FY 2009 level was 12% over the average of the previous three years, during which NIH funding was relatively flat.[8]

Collectively, Maryland-based institutions are major recipients of NIH funding among states. In FY2010 the state accounted for $1.0 billion in NIH funding grants or 4.6% of the national level, sixth in the country. On a per capita basis, Maryland NIH funding reached $179 per person during 2010. This was the third highest level of NIH funding intensity in the country, behind Massachusetts and the District of Columbia.

Table 10

NIH Funding			
Leading States	**Total $(millions)**	**Leading States**	**$ Per capita**
California	3,332.4	Massachusetts	371.24
Massachusetts	2,447.3	District Of Columbia	295.90
New York	2,001.0	**Maryland**	**179.11**
Pennsylvania	1,405.9	Rhode Island	141.71
Texas	1,078.1	Connecticut	135.18
Maryland	**1,018.8**	Washington	126.89
North Carolina	932.0	Pennsylvania	111.56
Washington	846.5	New York	102.50
Illinois	732.7	North Carolina	99.60
Ohio	662.4	Vermont	96.79
United States Total	**22,234.6**		**72.51**

Source: DBED calculations on NIH and U.S. Census data

[8] Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*, p. 42-43.

Academic Life Sciences Research

Maryland's quality colleges and universities play several key roles in the state's life sciences economy. First they support a high concentration of academic activity, which attracts well-educated workers with specialized skills. This influx has positive spillover effects on private life sciences firms and on federal agencies by making it easier to for them to meet their requirements for highly talented labor. In addition life sciences researchers typically can move rather fluidly among private firms, federal organizations and academia.[9] This fluid movement facilitates the formation of networks and relationships among these skilled workers, increasing cooperation and partnerships among researchers in the three groups to the benefit of all.

Maryland's institutions of higher learning produce a relatively high volume of advanced degree graduates from life sciences-related programs, providing additional support for the state's skilled workforce. During the 2008-2009 academic year, for example, the state's colleges and universities graduated 196 doctoral candidates in the biological and biomedical sciences—the 11th highest number of graduates among states. Maryland institutions also graduated 525 masters candidates in the same field—the third highest total in the country. Altogether Maryland institutions graduated 721 post-graduate candidates in biological and biomedical sciences. Despite the state's relatively small size, this level was sixth highest total of graduates in the country (Table 11).

Table 11

Postgraduate Degrees Awarded in Biological and Biomedical Sciences Academic Year 2008-2009

Rank	State	Master's	Doctoral	Total
1	California	767	765	1,532
2	New York	810	553	1,363
3	Texas	653	479	1,132
4	Pennsylvania	492	322	814
5	Massachusetts	355	409	764
6	**Maryland**	**525**	**196**	**721**
7	Illinois	424	213	637
8	Michigan	327	197	524
9	Ohio	274	235	509
10	North Carolina	208	257	465
	United States	8,765	6,335	15,100

Source: National Center for Education Statistics.

Maryland's academic life sciences plays another key role through its basic life sciences research. Top research universities are more likely to engage in basic life sciences research than other life sciences participants. The development of life sciences products and services depends heavily upon basic research, highlighting the importance of basic research as a support for life sciences economic activity. As a result, strong academic research funding in a region is vital for the region's ability to develop and

[9] Milken Institute, *The Value of U.S. Life Science: A White Paper Exploring Competitiveness, Delivery and Challenges*, http://www.milkeninstitute.org/publications/publications.taf?function=detail&ID=38801194&cat=resrep, p. 16.

commercialize promising biopharmaceutical initiatives. According to the Milken Institute, academic research funding is therefore an indicator of both a region's future innovative capacity and its ability to commercialize research results.[10]

Table 12

Academic Life Sciences Research & Development Spending 2009			
Rank	State	Life Sciences R&D Spending	
		$(millions)	Dollars per capita
1	Maryland	$1,450	$254
2	Massachusetts	$1,203	$182
3	North Carolina	$1,621	$173
4	Connecticut	$606	$172
5	Vermont	$103	$165
6	Nebraska	$268	$149
7	Wisconsin	$821	$145
8	New York	$2,693	$138
9	Missouri	$821	$137
10	Pennsylvania	$1,656	$131
--	United States	$32,791	$107

Source: DBED calculations based on data from NSF, National Center for Science and Engineering Statistics and the Census Bureau.

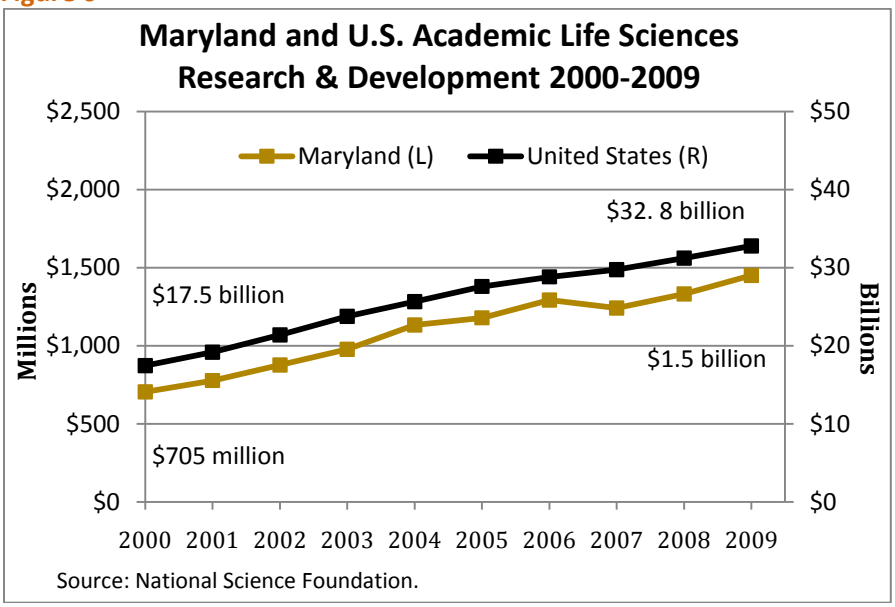
This understanding highlights the importance of the state's leadership in academic life sciences research. In FY 2009 Maryland academic institutions conducted $1.45 billion in life sciences research and development. This spending level ranked the state sixth in the country. In addition, at $254 per person, Maryland institutions spent more intensively on life sciences research and development per capita than any other state and over twice the national level (Table 12 above).[11]

The level of spending in 2009 was more than double the 2000 level and reflects a similar doubling nationwide (see Figure 6). As shown in Table 13, Johns Hopkins University alone received $787 million for life sciences research and development in FY 2009.

[10] Milken Institute, *The Value of U.S. Life Sciences*, p. 27.

[11] The District of Columbia had a higher level of per capita spending with $403 per person.

Figure 6



Maryland and U.S. academic life sciences R&D spending roughly doubled from 2000 to 2009

Table 13

R&D Expenditures at Maryland Universities & Colleges FY 2009 $(1,000s)		
Academic Institution	**All R&D expenditures**	**Life Sciences**
Frostburg State University	215	215
Goucher College	269	197
Johns Hopkins University	1,856,270	787,092
Morgan State University	12,351	1,673
St. Mary's College of Maryland	338	157
Towson University	4,025	465
Uniformed Services U. of Health Sciences	192,268	188,911
University of Maryland Baltimore	359,542	359,542
University of Maryland Baltimore County	75,571	5,093
University of Maryland Biotechnology Institute	45,921	32,029
University of Maryland College Park	409,190	70,997
University of Maryland Eastern Shore	7,504	4,038

Source: National Science Foundation

Most studies on the life sciences industry acknowledge the importance of academic research but do not attempt to quantify the jobs or economic activity that it generates. Recognizing that academic life sciences is a vital and sizable component of Maryland's life sciences economy, DBED explicitly includes this segment of the industry in this study. DBED's investigation found that academic life sciences exerted a considerable direct economic impact on the state economy. DBED performed these estimates by using NSF data on 2009 academic life sciences research spending to estimate 2010 academic life sciences research spending. The 2010 spending quantities were then introduced to the IMPLAN ® Regional Economic model for Maryland. This analysis resulted in estimates that academic life sciences research accounts for 8,240 direct jobs, $692.7 million in wages and salaries and an average annual salary of $84,070.

Total Economic Impact in Maryland

The total economic impact of life sciences in Maryland includes the indirect and induced effects, together known as secondary effects. Indirect effects encompass jobs at Maryland firms not directly identified as life sciences firms, but which enable life sciences facilities to operate by supplying key supplies and/or services. Induced effects include jobs supported by the local spending of Maryland residents that work in life sciences. DBED estimated the secondary effects by applying the direct effect to the IMPLAN® Regional Economic Model for Maryland.

DBED's analysis of the economic impact of Maryland's life sciences finds that Maryland life sciences supported a total of 160,030 jobs, $9.6 billion in wages and salaries and nearly $500 million in tax revenues. Table 14 indicates that of those 160,030 jobs, 79,793 were from the private sector, 62,150 were from the federal sector and 18,088 were generated from academic life sciences.

Table 14

Maryland Economic Impact of Life Sciences Activity 2010			
Category	**Direct Impact**	**Secondary Effects**	**Total Impact**
Jobs			
Private	33,602	46,191	79,793
Federal	29,777	32,373	62,150
Academic	8,240	9,848	18,088
Total	71,618	88,412	160,030
Wages & Salaries $(millions)			
Private	$3,058.9	$1,850.0	$4,908.9
Federal	$2,772.8	$891.3	$3,664.1
Academic	$692.7	$345.9	$1,038.7
Total	$6,524.4	$3,087.3	$9,611.7

Of the secondary impacts Table 15 indicates that 28,246 of these were *indirect jobs*, meaning they were based at Maryland-based firms and agencies that supplied or supported Maryland's life sciences sector. Another 60,166 jobs were *induced jobs*, meaning that these jobs were supported by the consumer spending of Maryland residents holding either life sciences sector jobs or support/supply jobs.

Table 15

Maryland Economic Impact of Life Sciences Activity 2010				
Quantity	**Direct**	**Secondary Effects**		**Total**
		Indirect	**Induced**	
Jobs	71,618	28,246	60,166	160,030
State Gross Domestic Product	$17.6 billion	$7.2 billion	$12.2 billion	$37.1 billion
Wages & Salaries	$6.5 billion	$1.2 billion	$1.9 billion	$9.6 billion
Annual Average Wages & Salaries per Job	$91,100	$41,589	$31,788	$60,062

Source: DBED calculations using publicly available data and the IMPLAN® Regional Economic Model for Maryland

The 28,246 indirect jobs supported by Maryland life sciences in 2010 spanned diverse industries and economic activities. For example, Maryland-based companies providing services to buildings and dwellings accounted for 2,900 indirect jobs as did employment services firms (other than executive

search). This means that those roughly 5,800 jobs were accounted for though support activities for Maryland life sciences. The wholesale trade industry accounted for over 1,600 indirect jobs. Management companies and enterprise services industry accounted for over 1,600 indirect jobs and food services and restaurants accounted for 1,450 indirect jobs.

The expenditures associated with life sciences salaries and wages produce substantial tax revenues for the state. These revenues include, but are not limited to state personal income tax and state retail sales tax. The direct annual fiscal impact of life sciences in Maryland seen in Table 16 is estimated to be $334.7 million in selected state tax receipts in 2010. The secondary fiscal impact of life sciences amounts to an estimated $136.7 million. The total annual fiscal impact of the life sciences is estimated to be $471.4 million in selected state taxes.

Table 16

Fiscal Impact of Life Sciences Activity 2010 $(millions)				
Quantity	Direct	Secondary Effects		Total
		Indirect	Induced	
Tax Revenues from wages & salaries				
Maryland Personal Income Tax	$182.7	$31.1	$21.6	$235.4
Maryland Sales & Use Tax	$152.0	$23.4	$60.6	$236.0
Total	$334.7	$54.5	$82.2	$471.4

Source: DBED calculations using publicly available data and the IMPLAN® Regional Economic Model for Maryland

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Appendix

Defining Life Sciences

There is no universally accepted understanding of what encompasses that economic activity variously known as the "life sciences," "biotechnology," "biosciences" or other related terms. However an exploration of the employment and economic impact that this economic activity exerts on Maryland (or any other region) requires the creation of a defensible definition.

DBED reviewed numerous reports on the life sciences in order to understand the breadth of approaches used by previous researchers to define "life sciences" economic activity. At their heart, these approaches incorporated the basic concept that the life sciences involved the application of knowledge regarding "the way in which plants, animals and humans function" for the development or production of desirable products or services. [12] These products could range from the production of drugs and medical devices to the production of biofuels. These services could include the development and testing of *new improved* drugs and medical devices and many other related services. The unifying principle was that "life sciences" activity was defined *not* necessarily by the nature of the goods or services it produces, but by the nature of the technology it uses—knowledge of biological processes. [13]

Therefore a clear requirement of any life sciences definition was that it should incorporate the above principle. However DBED's "life sciences" definition must also recognize in Maryland, the federal government and academic institutions account for a highly significant share of the state's life sciences activity. In order to recognize these important roles, DBED used a three-pronged definition that divided the state's life sciences facilities and organizations into a private sector, a federal and an academic category.

Private Sector Life Sciences

DBED's review of previous life sciences reports identified three major reports that stood out as prototypes for diverse approaches to defining and quantifying this field. These three reports were "The Value of Life Sciences: A White Paper Exploring Competitiveness, Delivery and Challenges" from the Milken Institute, "Signs of Life: the Growth of Biotechnology Centers in the U.S." by The Brookings Institution and "Battelle/BIO State Biosciences Initiatives 2010" by Battelle Technology Partnership Practice.

In all three reports the life sciences sector definitions used were built on specified industries selected from those available in the North American Industrial Classification System (NAICS). The NAICS is a hierarchical industrial categorization system that ultimately divides all economic activity into mutually exclusive categories generally by the goods or services that said economic activity produces.[14] In addition, each of the three reports estimated the size of its defined life sciences sector using the Quarterly Census of Employment and Wages (QCEW). The QCEW is considered the most accurate count available of nonfarm payroll jobs, wage levels and number of establishments down to the state and county level. This accuracy results from a "near census" performed by the Bureau of Labor Statistics

[12] Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*, p. *i*.
[13] The Brookings Institution, *Signs of Life, The Growth of Biotechnology Centers in the U.S.*, http://www.brookings.edu/reports/2002/06_biotechnology_cortright.aspx, p. 6.
[14] Bureau of Labor Statistics (2010). "North American Industry Classification System (NAICS) at BLS."

(BLS) and associated agencies to obtain this information. BLS categorizes QCEW jobs, aggregate wages and establishments[15] data by geography, as well as by NAICS industry.[16]

DBED limited its QCEW-based approach to its estimate for the private life sciences. This was because DBED could take advantage of more comprehensive approaches, as outlined in the report methodology, to estimate federal and academic life sciences.

The Milken report (Table 17) uses an expansive approach to defining life sciences. The Milken definition incorporates specified manufacturing activities and services activities commonly associated with life sciences. On the manufacturing side, Milken includes drugs and pharmaceuticals manufacturing and electromedical and surgical equipment manufacturing. On the services side, Milken includes biotechnology research and development. The Milken definition stands out for incorporating a substantial segment of health care services in life sciences definition.[17]

The Brookings Institution's definition is similar in concept to the Milken definition (Table 18). It includes manufacturing of drugs and pharmaceuticals and biotechnology research and development services, as does Milken. Unlike Milken it excludes manufacturing of electromedical and surgical devices and all health care services.[18]

The Battelle Institute's definition is narrower than the Milken approach and broader than that used by the Brookings Institution. However in some ways, it covers more ground than both. In this way the Battelle definition represents a moderate approach between these two examples. The Battelle definition, for example, includes the manufacturing drugs and pharmaceuticals as well as biotechnology research and development services. In this way, Battelle matches both Milken and Brookings. In addition Battelle matches Milken (but not Brookings) by including the manufacture of electromedical and surgical devices and equipment. However unlike either Milken or Brookings, Battelle includes industries representing the manufacture of agricultural feedstock and agricultural chemicals. Finally Battelle matches Milken in including some health care services in its definition, but, unlike Milken, limits it to testing and diagnostic laboratories. [19]

Battelle's definition, as does DBED's, indicates that in the case of two NAICS industries, only a portion of the amount attributed to the industry is included in the life sciences definition (see Table 3 and Table 19). One of the industries is NAICS 541380, Testing Laboratories. The other is NAICS 541712, Research and Development in the Physical Engineering and Life Sciences (except Biotechnology). DBED addressed this by using data from the Economic Census to distinguish that portion of each industry to attribute to life sciences activity, from that portion to exclude.

For estimates covering periods prior to 2007, DBED applied data from the 2002 Economic Census. For estimates covering periods after 2006, DBED used data from the 2007 Economic Census. The 2002

[15] BLS defines an establishment as an economic unit, "such as a factory, mine, store, or office that produces goods or services." Generally there is one establishment for each location, although there can be exceptions. Also it is possible for an organization to account for more than one establishment. For example, in the private sector, a firm could own or operate multiple establishments. In this report, DBED equates the BLS concept of "establishments" emerging from its labor data, to the life sciences concept of "facilities." Thus the terms "establishments" and "facilities" are used interchangeably in discussing private sector life sciences. See Bureau of Labor Statistics. "BLS Handbook of Methods, Chapter 2. Employment, hours, and earnings from the establishment survey."

[16] Bureau of Labor Statistics (2003). "Quarterly Census of Employment and Wages: Overview."

[17] Milken Institute, *The Value of U.S. Life Sciences*, pages 6-7.

[18] Brookings Institution, *Signs of Life, The Growth of Biotechnology Centers in the U.S.*, p. 7.

[19] Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*, p. 16.

Economic Census indicated that DBED should assume that during 2002-2006, 17.8% of Maryland jobs, wages and establishments in NAICS industry 541380 and 54.5% of Maryland jobs, wages and establishments should be attributed to life sciences. For the period 2007-2010, the 2007 Economic Census indicated that those percentages should be 0.0% and 42.6% respectively. DBED used these percentages to assist in estimating Maryland private life sciences quantities using Battelle's and its own definition.

DBED selected the Battelle definition as a basis for its own. However DBED's took advantage of specialized information it had about its own life sciences sector to apply changes to the Battelle definition that would allow it to better reflect Maryland's private life sciences economy. The most notable were the removal of NAICS 311221, 311222, 311223, 311223 and 325193 from its definition and the addition of NAICS 541690 Other Scientific and Technical Consulting Services. Figure 7 compares the number of life sciences jobs in Maryland according to each definition.

Table 17

Milken Institute Life Sciences Definition	
NAICS	**NAICS Industry Title**
Therapeutics & Devices	
3254	Pharmaceutical and Medicine Manufacturing
32541	Medicinal and Botanical Manufacturing
32541	Pharmaceutical Preparation Manufacturing
32541	In-Vitro Diagnostic Substance Manufacturing
32541	Biological Product (except Diagnostic) Manufacturing
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334517	Irradiation Apparatus Manufacturing
3391	Medical Equipment and Supplies Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing
339114	Dental Equipment and Supplies Manufacturing
339115	Ophthalmic Goods Manufacturing
339116	Dental Laboratories
541711	Research and Development in Biotechnology
Health Care Services	
621	Ambulatory Health Care Services
62111	Offices of Physicians (except Mental Health Specialists)
62111	Offices of Physicians, Mental Health Specialists
62121	Offices of Dentists
62131	Offices of Chiropractors
62132	Offices of Optometrists
62133	Offices of Mental Health Practitioners (except Physicians)
62134	Offices of Physical, Occupational and Speech Therapists, and Audiologists
62139	Offices of Podiatrists
62139	Offices of All Other Miscellaneous Health Practitioners
62141	Family Planning Centers
62142	Outpatient Mental Health and Substance Abuse Centers
62149	HMO Medical Centers
62149	Kidney Dialysis Centers
62149	Freestanding Ambulatory Surgical and Emergency Centers
62149	All Other Outpatient Care Centers
62151	Medical Laboratories
62151	Diagnostic Imaging Centers
62161	Home Health Care Services
62191	Ambulance Services
62199	Blood and Organ Banks
62199	All Other Miscellaneous Ambulatory Health Care Services
622	Hospitals
62211	General Medical and Surgical Hospitals
62221	Psychiatric and Substance Abuse Hospitals
62231	Specialty (except Psychiatric and Substance Abuse) Hospitals
623110	Nursing Care Facilities

Source: Milken Institute, *The Value of U.S. Life Sciences*, p. 6-7.

Table 18

Brookings Life Sciences Definition	
NAICS	**NAICS Industry Title**
3254	Pharmaceutical and Medicine Manufacturing
325411	Medicinal and Botanical Manufacturing
325412	Pharmaceutical Preparation Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
541711	Research and Development in Biotechnology

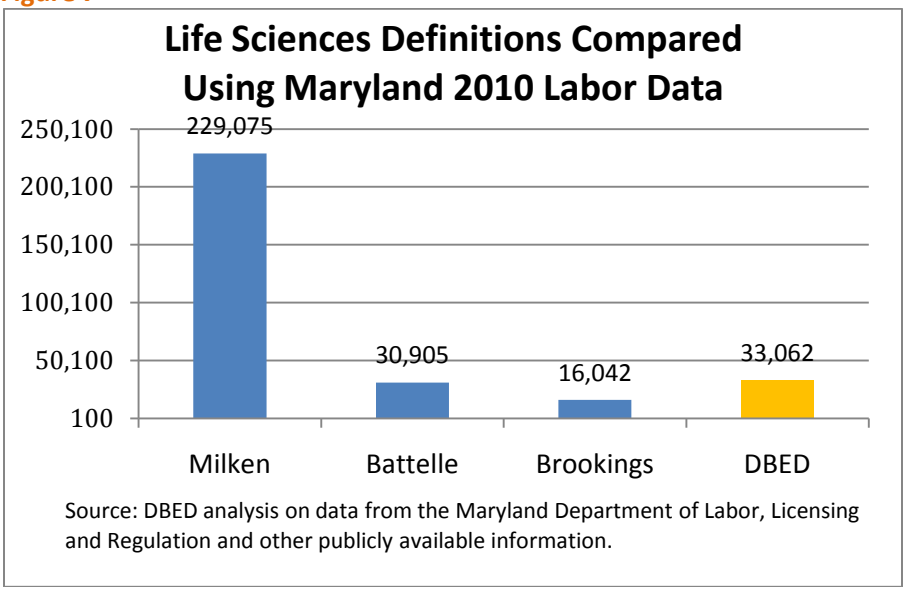
Source: The Brookings Institution, *Signs of Life, The Growth of Biotechnology Centers in the U.S.*

Table 19

Battelle Institute Bioscience Definition	
NAICS	**NAICS Industry Title**
Agricultural Feedstock and Chemicals	
311221	Wet Corn Milling
311222	Soybean Processing
311223	Other Oilseed Processing
325193	Ethyl Alcohol Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325221	Cellulosic Organic Fiber Manufacturing
325311	Nitrogenous Fertilizer Manufacturing
325312	Phosphatic Fertilizer Manufacturing
325314	Fertilizer (Mixing Only) Manufacturing
325320	Pesticide and Other Agricultural Chemical Manufacturing
Drugs and Pharmaceuticals	
3254	Pharmaceutical and Medicine Manufacturing
325411	Medicinal and Botanical Manufacturing
325412	Pharmaceutical Preparation Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
Medical Devices and Equipment	
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334516	Analytical Laboratory Instrument Manufacturing
334517	Irradiation Apparatus Manufacturing
3391	Medical Equipment and Supplies Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing
339114	Dental Equipment and Supplies Manufacturing
339115	Ophthalmic Goods Manufacturing
339116	Dental Laboratories
Research, Testing and Medical Laboratories	
541380*	Testing Laboratories
541711	Research and Development in Biotechnology
541712*	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
6215	Medical and Diagnostic Laboratories
621511	Medical Laboratories
621512	Diagnostic Imaging Centers

* Battelle includes only a portion of the establishments in these industries.
Source: Battelle Technology Partnership Practice, *Battelle/BIO State Bioscience Initiatives 2010*, p. 16.

Figure 7



Source: DBED analysis on data from the Maryland Department of Labor, Licensing and Regulation and other publicly available information.

Federal Life Sciences

Federal government investments in Maryland have been an important part of the Maryland economy for many years. For this reason, DBED has closely tracked federal facilities and employment at these facilities using public records and discussions with both federal experts and local officials in areas where the facilities are located. This has enabled DBED to estimate employment at the federal facilities listed in Table 9. DBED estimated federal life sciences wages and salaries by taking a weighted average of the Maryland 2010 QCEW data for federal employees employed at research laboratories and for all federal employees in Maryland.

Academic Life Sciences

Academic life sciences directly employed jobs and salaries were estimated in the manner described in the text.

Impact Analysis

Secondary impacts were estimated by introducing estimates for private, federal and academic life sciences direct jobs and salaries to the IMPLAN ® Regional Economic Model for Maryland. Private life sciences jobs, other than research jobs were introduced to the model as changes in employment to IMPLAN sectors corresponding to each NAICS industry attributed to that quantity of jobs. In order to accurately capture the secondary impacts of research activities, estimated academic direct jobs and a portion of federal direct jobs were introduced to the model as research and development services employment. The IMPLAN model's assumptions about the average employee compensation of workers in the research and development differed materially from the averages found in the 2010 QCEW data for researchers in Maryland. In order to reflect these differences, DBED introduced assumptions about this employee compensation to better reflect the data findings.

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