Overview and Summary of Recent Initiatives

Maryland continues to offer a comprehensive set of efforts that address R&D, research facilities, commercialization, financing, tax policy, and workforce as the state continues to seek to create a business climate that nurtures the growth of its bioscience sector. In his proposed FY 2007 budget, Governor Robert Ehrlich proposed a number of new science and technology initiatives, many of which are targeted to the biosciences. They include $66 million for infrastructure and research funding, of which $12 million is proposed in new capital funds for the Center for Regenerative Research and University of Maryland-Baltimore's (UMB's) BioPark; $2.3 million in capital funds for a new Biological Sciences Research Building at the University of Maryland, College Park; and $28.1 million in operating funds for the Cigarette Restitution Fund for Cancer Research.

A number of tax policy changes were made since 2004, and additional proposals are under consideration by the Legislature. The state's R&D tax credit was reauthorized in 2004, and a Biotechnology Investment Incentive Act was enacted in 2005. This bill created a tax credit against state income tax for individuals, corporations, and venture capital firms that invest in qualified biotechnology firms. Legislation is pending that would appropriate $6 million in operating funds to implement the Biotechnology Tax Credit. (See description under "Pre-seed and seed capital.")

Lastly, development of new bioscience research parks in Baltimore continues to move forward. UMB completed the first of seven buildings and has a second building underway at its 8-acre BioPark; and planning continues for the East Baltimore Life Science and Technology Park, which is being developed in proximity to Johns Hopkins University.

Building Bioscience R&D Capacity

Recent state investments in facilities

CARB II: With funding approved in 2003 and construction begun in 2004, the State of Maryland approved a $50 million expansion of the University of Maryland Biotechnology Institute's (UMBI) **Center for Advanced Research in Biotechnology (CARB).** CARB conducts research and provides interdisciplinary training on fundamental problems in biotechnology. The new expansion, referred to as CARB II, will comprise 140,000 square feet and contain state-of-the-art laboratories, key core facilities such as BSL-3 containment, and plant and insect transformation capabilities, as well as specialized infrastructure for industry workforce training programs in areas of critical need such as production of small molecules and biologics under good manufacturing practices (GMP) to support sustained commercialization of biotechnology. CARB II will be operational in fall 2006.

UMB College of Life Sciences Bioscience Research Building: In October 2004, the groundbreaking ceremony was held for the University of Maryland, College Park's new Bioscience Research Building of the College of Life Sciences, which received $50 million in state funding. The new facility will promote interaction and collaboration of researchers across disciplines. By example, the college is a partner, with the Clark School of Engineering and the College of Computer, Mathematical and Physical Sciences, in the university's initiative in nanoscience and bionanotechnology in particular.

Research programs

The **University of Maryland Biotechnology Institute** was created in 1985 to conduct research and training and provide expertise and facilities to advance the development of the state's biotechnology sector. UMBI received $15 million in state general funds for operation in FY 2005 and approximately $35 million in sponsored research. UMBI includes five centers:

- **CARB:** A cooperative venture of UMBI, the National Institute of Standards and Technology, and Montgomery County, CARB is UMBI's premier center of excellence in protein structure and engineering, and other molecular studies.

- **Center for Biosystems Research (CBNR):** CBNR promotes research and training in the application of multiple scientific disciplines to study complex biological systems. Facilities include the University System of Maryland's primary DNA Sequencing Facility and a microarray production and analysis core facility, both of which provide a variety of services to UMBI and the research community at large.

- **Center for Marine Biotechnology (COMB):** COMB's unique, state-of-the-art facilities include DNA synthesis, sequencing, and quantifying equipment; fermentation systems for growth of extremophilic microorganisms; biological safety level 3 (BSL-3) suites; a core facility for transgenic work; and a fully contained aquaculture facility that is designed for conducting cutting-edge research to develop and improve finfish/shellfish production and hatchery technologies.

- **Medical Biotechnology Center (MBC):** MBC focuses on molecular medicine and aims to provide intellectual property to companies for development and commercialization of new products and technologies. The center houses the National Center for Fluorescence Spectroscopy of the University of Maryland School of Medicine.

- **Institute of Human Virology (IHV):** IHV focuses on the discovery of diagnostics and therapeutics for human viral diseases and cancer. Its facilities include a viral immunology core laboratory, a clinical trials unit, a state-of-the-art flow cytometry facility, the "mQuant" core services laboratory, and the Evelyn Jordan outpatient facility.

Encouraging Academic/Industrial Interaction

The **Maryland Industrial Partnerships (MIPS)** program provides matching funds for university-based research projects that help companies develop new products. The funds are awarded on a competitive basis with the maximum annual award of $100,000 for small, medium, and large companies and $70,000 for start-up companies. Projects can be funded for 1 or 2 years. Both cash and in-kind match are required. The amount of match depends on the size of the company. The annual MIPS budget is $1.35 million; however, the Governor has proposed a $1 million increase in funding for FY 2007. Examples of successful bioscience products that received MIPS funding are MedImmune's $1.6 billion Synagis, which

prevents a respiratory disease in infants, and Martek Biosciences' additive for infant formulas, which helped the company generate $114 million in revenue

Moving Technology into the Marketplace

Commercializing university technology

The mission of the state-sponsored **Maryland Technology Development Corporation (TEDCO)** is to create and sustain businesses throughout the State of Maryland through the development, commercialization, and deployment of technology. The organization's **University Technology Development Fund (UTDF)** helps universities conduct precommercial feasibility research on very early-stage technologies. The objective is to enhance the value of university technologies so they are more likely to be licensed. UTDF can provide up to $50,000 to cover the cost of feasibility demonstration projects. The program's FY 2006 budget is $450,000.

Supporting bioscience entrepreneurs and emerging companies

The Biotechnology Program of the **University of Maryland's Technology Enterprise Institute** links biotechnology businesses with University of Maryland researchers and provides ongoing technical assistance to these companies in their ongoing R&D efforts for product scale-up. The program includes a **Bioprocess Scale-up Facility** that offers services in fermentation, separation, purification, and product analysis to companies, academic researchers, and federal laboratories.

The State of Maryland, through its Department of Business and Economic Development (DBED), has both formal and informal business development services available for Maryland-based companies, but these services are not restricted to bioscience companies. The International Division of DBED has the PATHFINDER program that provides overseas tradeshow representation, where trade specialists will attend a trade show for a Maryland company and execute on the elements of the strategy developed by the company.

MdBio, a nonprofit organization that is now part of the Tech Council of Maryland and has been renamed MdBio Foundation, provides up to 2 days of consulting services for any aspect of business development—this assistance is provided by consultants on contract with MdBio.

Making Capital Available

Pre-seed and seed capital

TEDCO's **Maryland Technology Transfer Fund (MTTF)** program provides seed funding of up to $75,000 for companies that engage in technology development and transfer collaborations with universities and/or federal laboratories in Maryland. The funds are awarded on a competitive basis with a 60-day review cycle that begins the first of every month. Projects are typically 6 months, depending on the nature of the development proposed. Companies are required to provide a 50 percent match to TEDCO funds. Match funds may be cash or in kind. MTTF awards have a repayment obligation based on gross revenues that is time-limited and capped at a maximum of twice the award amount. TEDCO's budget for FY 2006 for the MTTF is $1.5 million.

DBED administers several programs that provide funding for early-stage companies. The **Challenge Investment Program (CIP**) makes small, high-risk investments in start-up firms. A company can receive

up to $150,000, with a typical initial investment averaging $50,000. Incremental investments are awarded based upon the company's performance and ability to achieve milestones set by DBED. CIP funds can be used to help offset the costs of final testing and market development. In return for its investment, the state receives a royalty payment tied to the achievement of certain thresholds or revenues and capital structure. The state's funds must be matched on a 1:1 basis.

DBED's **Enterprise Investment Fund (EIF) Program** makes direct equity investments in emerging high-technology companies. EIF investments, which range from $150,000 to $500,000, can be used for start-up costs including recruiting and hiring staff, operating costs, capital equipment, and R&D. The state's funds must be matched on a 3:1 basis by private-sector venture-capital funds. Based on the minimum matching requirements, the state's investments have leveraged at least $54 million; but, in reality, the companies the state has invested in have raised in excess of $300 million in private capital. A large percentage of both CIP and EIF investments have been in bioscience companies.

TEDCO's **Fort Detrick Technology Transfer Initiative (FDTTI**) provides seed funding for companies to develop and/or demonstrate medical technologies that meet the medical technology needs of the Army as defined by the U. S. Army Research and Materiel Acquisition Activity. FDTTI can award grants of up to $50,000 to for-profit companies in support of technology development projects.

MdBio Foundation has provided more than $4 million in project-based awards to 32 bioscience companies in Maryland since 1998. These **Project Accelerator Awards** are provided to companies who need an infusion of cash to accelerate the near-term commercialization of a product or service. The typical award is in the range of $100,000 to $200,000, and MdBio receives a royalty on the company's revenue and/or equity in the company.

The **Montgomery County Technology Growth Program (TGP)** provides gap financing for emerging technology-based companies with innovative products or services. Disbursements from the fund typically range between $50,000 to $150,000, and qualified technology businesses can choose to receive the funding in one of the following two ways:

- Term Loan—5-year term loan at a 10 percent fixed interest rate with a flexible repayment schedule.
- Grant Convertible to a Loan—A "no-risk" grant that converts to a loan if at any time within 5 years from the grant disbursement date the applicant generates prenegotiated annual net revenues or obtains a prenegotiated level of aggregate equity financing.

Maryland offers a **tax credit** against the state income tax for individuals, corporations, and venture capital firms that invest in qualified biotechnology firms. The value of the credit is 50 percent of an eligible investment made in a qualified biotechnology company during the taxable year. The maximum amount of the credit cannot exceed $50,000 for individuals and $250,000 for corporations and venture capital firms. The 2006 Legislature is considering a bill to authorize funding of $6 million to implement the tax credit program in FY 2007.

Venture capital

The State of Maryland through its **Enterprise Venture Fund** has invested in seven private venture-capital limited partnerships, with the understanding that each partnership will make its best efforts to invest in Maryland high-technology start-ups. A total of $16.5 million in state monies has been invested in funds representing more than $420 million. Five of the venture-capital partnerships invest in the bioscience sector. They include the following:

- Anthem Capital, an early-stage venture-capital firm that invests in IT/telecommunications and health care and life science companies in the mid-Atlantic region.
- Boulder Venture Limited, a venture-capital partnership with offices in the mid-Atlantic, California, and Colorado, which invests in IT and life science sectors.
- CIP Capital LP, which provides expansion and later-stage investments in life science, communications, and financial service companies.
- Toucan Capital, a $120 million venture fund in which the State of Maryland invested $4 million, which invests in early-stage technology companies. Approximately 60 percent of its investments, which range from $100,000 to $5 million, are in bioscience companies. Since 2001, the company has made eight investments, four of which were in Maryland.
- New Markets Growth Fund (NMGF), a $20 million venture-capital fund that makes equity investments and provides operational assistance to both early-stage ventures and small to mid-sized high-growth companies located in Maryland, Washington DC, and northern Virginia. NMGF will invest in all sectors, including the life sciences.

Providing Space for Bioscience Companies

Incubators

Maryland is home to a network of 20 business incubators, several of which are focused on bioscience companies. In total, these "bio-ready" incubators have approximately 108,500 square feet of laboratory space. They include the following:

- The **Alpha Center,** a nonprofit, private, biotechnology-focused incubator, is owned by Johns Hopkins University and the Hopkins Health System, which includes 18,000 square feet of wet-lab space.
- The **Association for Entrepreneurial Science** is a privately operated incubator that includes 20,000 square feet of wet-lab space. It is operated by the nonprofit Biomedical Research Institute.
- The **Technology Advancement Program** at the University of Maryland College Park, the state's oldest incubator, has approximately 10,000 square feet of wet-lab space.
- The **Maryland Technology Development Center** in Montgomery County has 18,000 square feet of wet-lab space.
- The **techcenter@UMBC**, University of Maryland, Baltimore County, includes 40,000 square feet of wet-lab space.
- The **Frederick Innovative Technology Center Inc.** includes 2,500 square feet of wet-lab space.

Facilities financing

The DBED has two existing economic development programs, the **Economic Development Opportunities Fund** and the **Maryland Industrial Development Finance Authority (MIDFA),** that have been used to assist biotechnology and life science companies in obtaining financing for facility

development. Although neither program is specific to biotechnology, these programs have been used by bioscience companies to help acquire land, construct laboratory facilities, purchase and install equipment, and meet the large investment capital needs of Maryland biotechnology companies as they scale up to manufacturing.

The Economic Development Opportunities Fund promotes Maryland's participation in extraordinary economic development opportunities that provide significant returns to the state through creating and retaining employment as well as creating significant capital investments. Participants must provide a minimum capital investment of at least five times the amount of the state's assistance. Significant companies that have been assisted by the fund include BioReliance, Qiagen, Human Genome Sciences, MedImmune, and Digene.

MIDFA encourages private sector financing in economic development projects through the use of insurance, the issuance of tax-exempt and taxable revenue bonds, and linked deposits. The use of insurance reduces the lender's risk in the project to an acceptable level. The project must be in a Priority Funding Area. MIDFA has supported some of Maryland's oldest and most significant companies including Guilford Pharmaceuticals, MedImmune, Human Genome Sciences, Avalon Pharmaceuticals, and Chesapeake Biological Laboratories.

Bioscience research parks

The **Shady Grove Life Sciences Center** is a 288-acre research park located on Maryland's I-270 technology corridor. The center, which was developed in 1983, is zoned exclusively for biotechnology and life science companies. In addition to more than 200 corporate tenants, the center houses the UMBI's Center for Applied Research in Biotechnology; the University of Maryland Shady Grove Center, a facility in which 11 different universities and colleges offer graduate and undergraduate courses; a campus of Johns Hopkins University; The Institute for Genomics Research; and a bioscience incubator.

The **UMB** is developing a BioPark on 8 acres of land adjacent to its campus in West Baltimore. The first of seven proposed buildings is completed and full, with construction of Building 2 underway and expected to be completed by mid 2007. The first building is 120,000 square feet of flexible laboratory and office space.

Under development

The **East Baltimore Life Science and Technology Park** is being developed by a nonprofit organization formed to redevelop 80 acres surrounding Johns Hopkins University. The project will include retail and residential development in addition to the park. The research park will be developed on 22 acres of the site and is expected to include 2 million square feet of space at build-out, which is expected to take place over the next 10 years.

The **East County Center for Science and Technology** is a proposed public/private partnership between Montgomery County, the Washington Suburban Sanitary Commission (WSSC), and Republic Properties Corporation. Under the proposed arrangement, a 115-acre site owned by WSSC located off Route 29 in eastern Montgomery County will be conveyed to the county with the idea of developing and constructing a science and technology park modeled after the county-owned Shady Grove Life Sciences Center in Rockville. Republic's preliminary plan calls for 800,000 square feet of development, including laboratory and biotech manufacturing facilities, a technology business incubator, a higher education facility, a telecommuter building, build-to-suit sites, and a daycare center. The county is currently negotiating the land transfer and development agreements with both WSSC and Republic. Once these agreements are in

place, planning, entitlement, and site plan work will continue throughout 2006 with the goal of initial groundbreaking in 2007. The entire project is likely to take 10 years to reach full build-out.

Addressing Talent Needs

Specialized postsecondary programs

The **BioTechnical Institute of Maryland, Inc. (BTI)** trains post-high-school graduates for entry-level positions in biotechnology. These candidates have training in Good Manufacturing Practices (GMP), Good Laboratory Practices, ISO 9000, metric system calculations of weights and measures, solution formulations, aseptic techniques, cell culture, basic molecular biology, and clean room and gowning techniques. In addition, all workers have certification in cardiopulmonary resuscitation and first aid. BTI is also a source for customized training programs to upgrade and validate employees' skills.

UMBI is a hub of intensive study into the basic science of biotechnology and its application to human health, the marine environment, agriculture, and protein engineering/structural biology. UMBI provides state-of-the-science laboratories, key core facilities, and training programs for the biotech workforce in areas of critical needs, such as production of small molecules and proteins under GMP to support sustained commercialization of biotechnology.

MdBioLab, a cooperative effort of MdBio, UMBI, and The Institute for Genomic Research, is a fully equipped, state-of-the-art mobile laboratory designed to expose high school students and their teachers to the biosciences. The laboratory provides hands-on experiences for students and informs them about career opportunities in the biosciences. It also is a resource for up-to-date bioscience curricula and ongoing professional development for high school teachers. The laboratory has been in operation since February 2003. To date, more than 35,000 students and 600 teachers have participated in programs in the MdBioLab.

Pending Proposals

Governor Ehrlich's proposed FY 2007 budget includes $66 million in funding for research and research facilities and more than $74 million for science and technology education. Proposed projects include the following:

- $12 million in new capital funds for the Center for Regenerative Research and the UMB BioPark.
- $28.1 million in operating funds for the Cigarette Restitution Fund for cancer research.
- $2.3 million in new capital funds for the new Biological Sciences Research Building at the University of Maryland, College Park.
- $49 million in new capital funds for the new Teacher Education and Technology Complex at Salisbury University.
- $18.8 million in new capital funds for eight projects at community colleges for classrooms to teach science.

- $2 million in net operating funds for bioengineering flagship initiative at the University of Maryland, College Park. This is a public/private partnership to create top-tier bioengineering academic programs to move forward in the knowledge economy.

- $2 million in new operating funds to create a Science, Technology, and Mathematics Academy to focus children in these subject areas to prepare for college.

An **Economic Development Stimulus** package also is under consideration in the Legislature that includes the following:

- $6 million in new operating funds to implement the Biotechnology Tax Credit passed in 2005 (see above).

- $2.5 million in new operating funds for the University System of Maryland Nanotechnology Research Initiative to encourage joint nano-biotechnology business development in Maryland and to develop bioscience-specific medical areas such as drug delivery, gene therapy, medical devices, and coatings where nanotechnology has a direct application.

- $1 million additional increase in funding for MIPS.

- $550,000 additional increase in operating funds for MTTF to provide follow-on funding to a select number of projects, which have demonstrated significant commercial potential.

In March 2006, the Maryland Legislature passed a **Stem Cell Research Bill** that will provide support for stem cell research without any restrictions on the source of the cells, that is, it allows the support of research using embryonic stem cells. The bill allows the Governor to determine the spending on an annual basis. The Governor has indicated that he plans to sign the legislation.

Legislation to create a **Maryland Biotechnology Tax Benefit Certificate Program** is also pending. This net operating loss (NOL) legislation allows biotechnology companies to sell unused research and development tax credits or NOLs carryover to another corporation. The legislation mandates that the seller receives at least 75 percent of the value of the tax credits. The total transfer of tax benefits is to no more than $20 million in 1 year. The maximum lifetime value of tax benefits that a corporation may surrender under the program is $4 million and is available only for companies with fewer than 225 employees, with 75 percent of its employees based in Maryland. Similar versions of the bill were introduced in both the House and the Senate.

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In 2006, the Tech Council of Maryland (TCM) and MdBio merged to form a new trade association that supports both life science and advanced technology companies throughout Maryland with advocacy, networking activities, and educational initiatives. The combined organization, called the Tech Council of Maryland, will have two operating divisions—MdBio and Tech Alliance. MdBio will serve the bio-science membership, and the Tech Alliance will work on behalf of the advanced technology community.

The nonprofit organization formerly known as MdBio has been renamed the MdBio Foundation and will serve as a support organization to the new MdBio.

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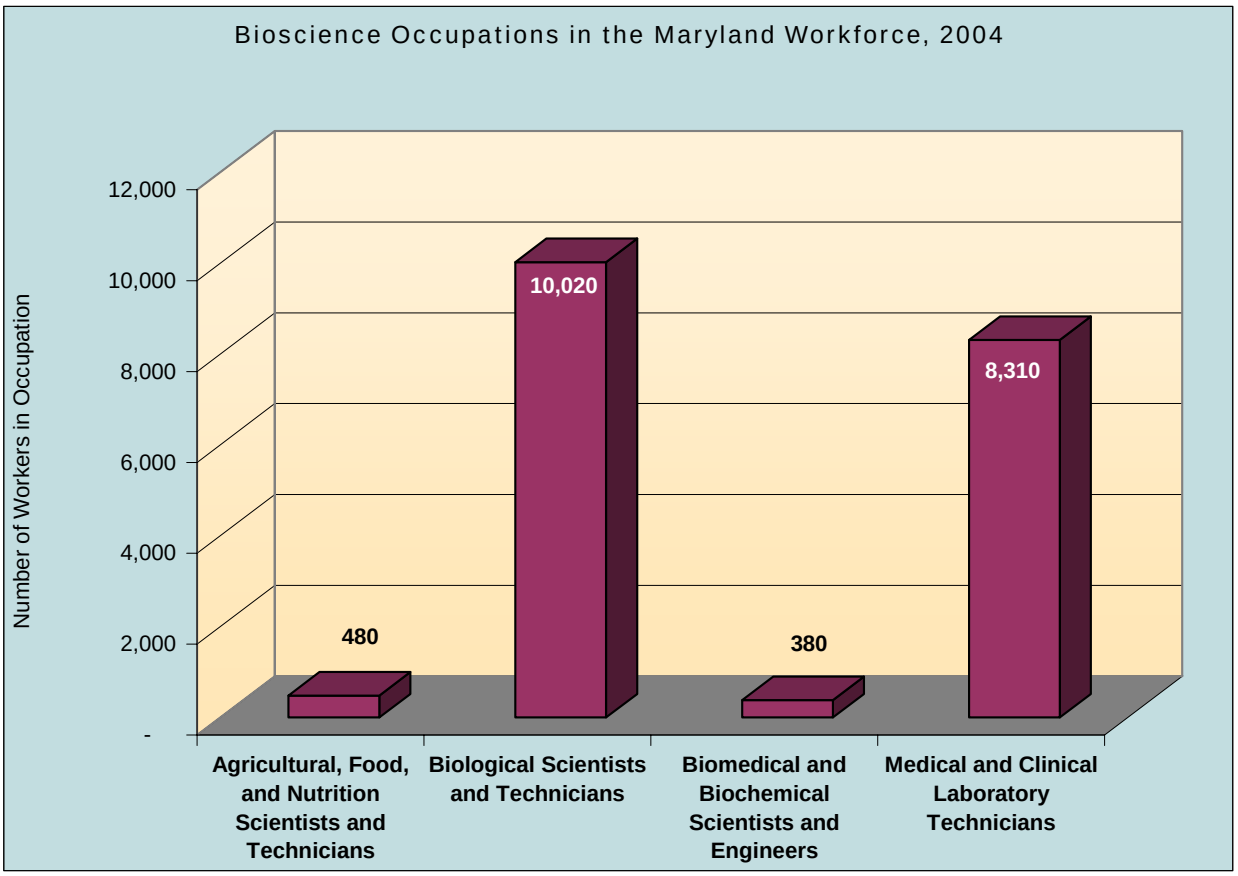
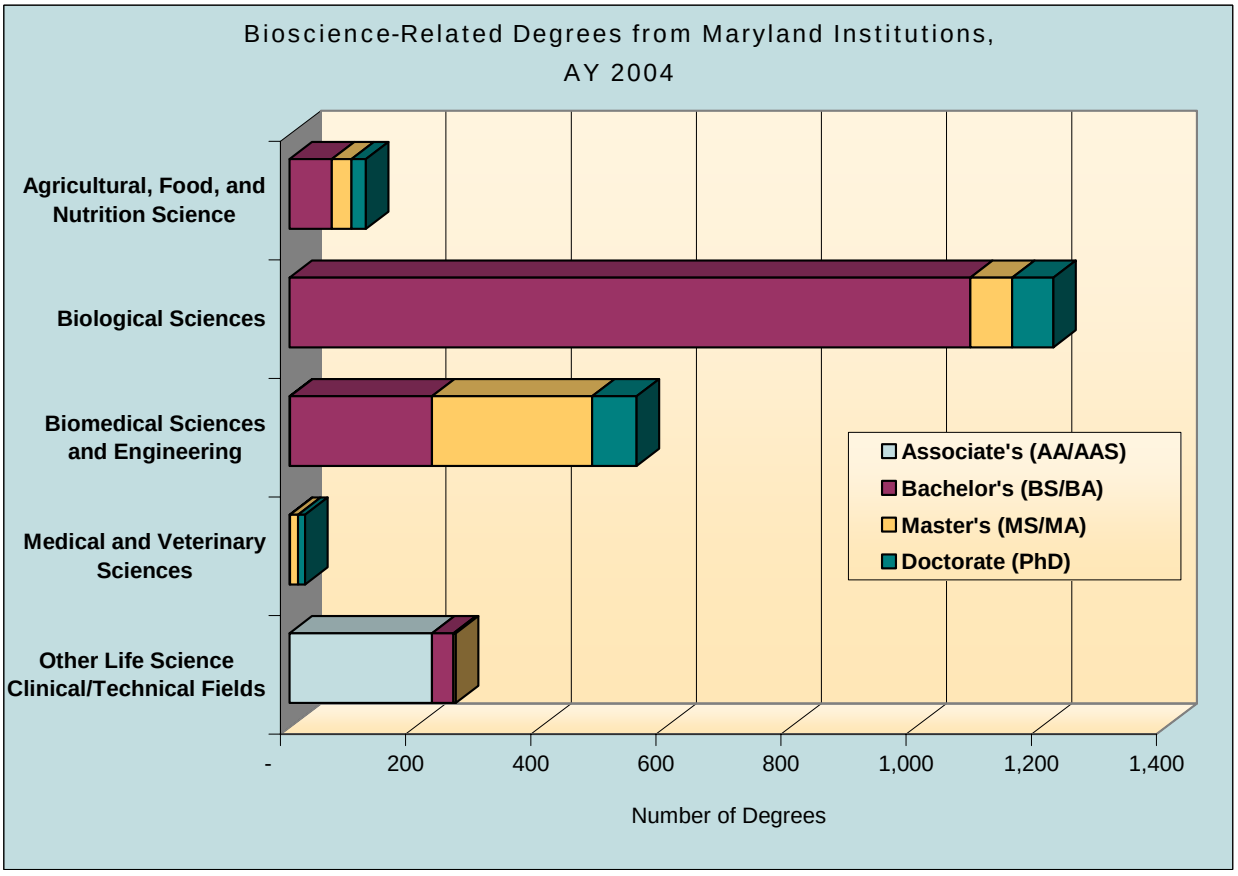
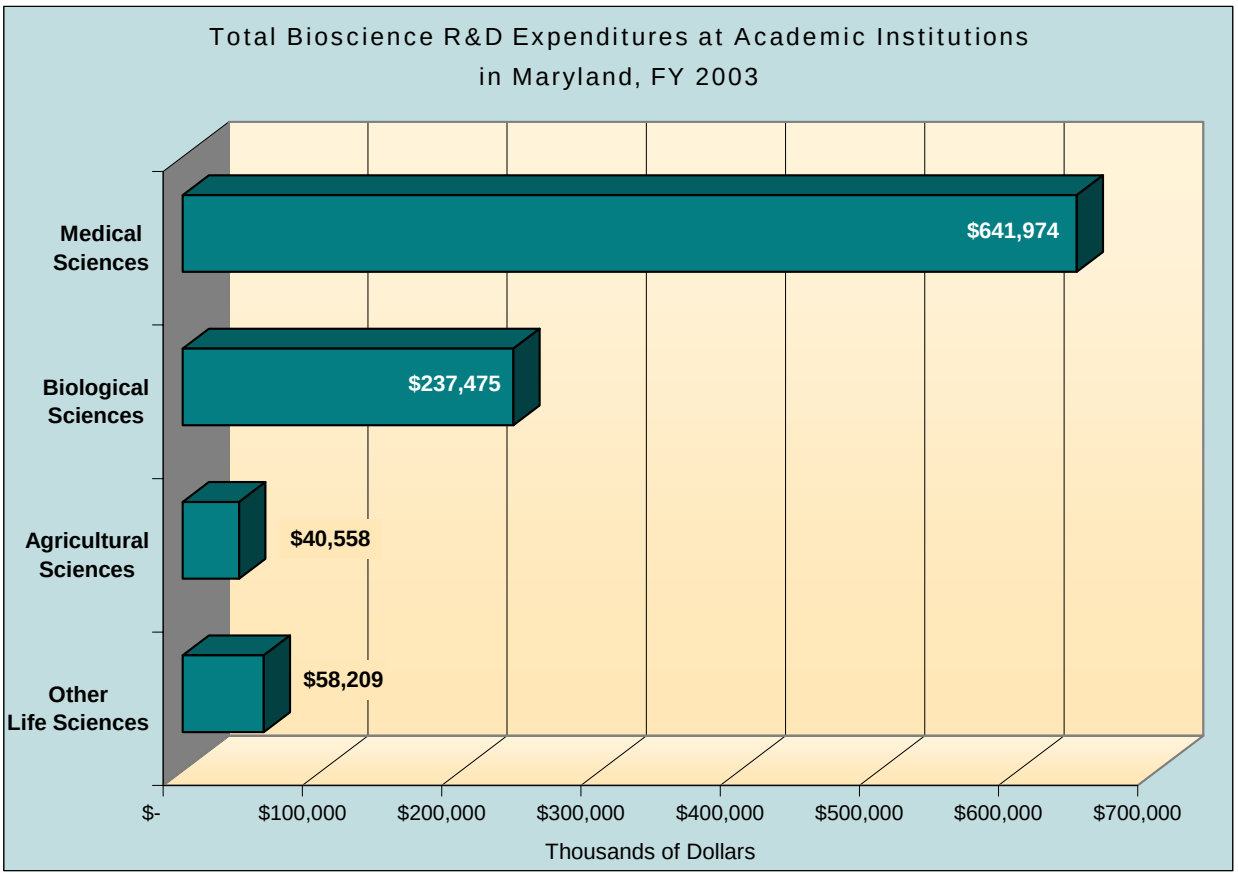
Industry Subsector	Maryland	United States
Agricultural Feedstock & Chemicals		
Establishments 2004	22	2,111
2001-2004 Establishment % Change	4.0%	0.4%
Employment 2004	437	104,893
2001-2004 Employment % Change	-25.0%	-6.9%
Share of U.S. Employment	0.4%	100.0%
Location Quotient	0.23	n.a.
Average Annual Wage 2004	$60,631	$63,383
Direct-Effect Employment Multiplier	4.37	10.91
Total Employment Impact	1,908	1,212,094
Drugs & Pharmaceuticals		
Establishments 2004	62	2,589
2001-2004 Establishment % Change	-8.8%	-0.6%
Employment 2004	5,240	313,207
2001-2004 Employment % Change	9.1%	2.7%
Share of U.S. Employment	1.7%	100.0%
Location Quotient	0.91	n.a.
Average Annual Wage 2004	$69,849	$79,303
Direct-Effect Employment Multiplier	4.55	9.51
Total Employment Impact	23,865	2,731,321
Medical Devices & Equipment		
Establishments 2004	244	15,190
2001-2004 Establishment % Change	-3.4%	0.2%
Employment 2004	2,961	411,460
2001-2004 Employment % Change	-1.3%	-3.6%
Share of U.S. Employment	0.7%	100.0%
Location Quotient	0.39	n.a.
Average Annual Wage 2004	$49,010	$56,449
Direct-Effect Employment Multiplier	2.79	4.56
Total Employment Impact	8,266	1,817,705
Research, Testing, & Medical Laboratories		
Establishments 2004	643	20,565
2001-2004 Establishment % Change	18.2%	19.4%
Employment 2004	15,244	413,550
2001-2004 Employment % Change	10.1%	8.2%
Share of U.S. Employment	3.7%	100.0%
Location Quotient	2.00	n.a.
Average Annual Wage 2004	$69,984	$65,414
Direct-Effect Employment Multiplier	2.31	3.15
Total Employment Impact	35,281	1,272,936
TOTAL PRIVATE SECTOR		
Establishments 2004	152,726	8,156,137
2001-2004 Establishment % Change	5.3%	4.8%
Employment 2004	2,014,206	109,249,195
2001-2004 Employment % Change	1.7%	-0.7%
Share of U.S. Employment	1.8%	100.0%
Location Quotient	n.a.	n.a.
Average Annual Wage 2004	$41,021	$39,003

Source: Battelle calculations -- based on Bureau of Labor Statistics QCEW data from the Minnesota Implan Group, RIMS II Employment Multipliers from the Bureau of Economic Analysis, and the Census Bureau's Economic Census.
Note: n.a. = metric is not applicable.


Bioscience Occupations in the Maryland Workforce, 2004
Number of Workers in Occupation
12,000
10,000
8,000
6,000
4,000
2,000
-
480
10,020
380
8,310
Agricultural, Food, and Nutrition Scientists and Technicians
Biological Scientists and Technicians
Biomedical and Biochemical Scientists and Engineers
Medical and Clinical Laboratory Technicians


Bioscience-Related Degrees from Maryland Institutions, AY 2004
Agricultural, Food, and Nutrition Science
Biological Sciences
Biomedical Sciences and Engineering
Medical and Veterinary Sciences
Other Life Science Clinical/Technical Fields
Associate's (AA/AAS)
Bachelor's (BS/BA)
Master's (MS/MA)
Doctorate (PhD)
-
200
400
600
800
1,000
1,200
1,400
Number of Degrees



	Maryland	United States	Rank
University R&D Expenditures, FY 2003			
Total ($ thousands)	$2,030,544	$40,104,621	4
Life Science R&D ($ thousands)	$992,585	$24,062,088	6
Percent of Total R&D	48.9%	60.0%	
Life Sciences Per Capita	$180.18	$82.74	
Change in Life Sciences FY 1999–2003	67.6%	52.7%	
NIH Support to Institutions, FY 2004			
Total ($ thousands)	$1,415,909	$22,556,459	4
Per Capita Expenditures	$257.02	$77.56	
Change in Expenditures FY 2000–2004	63.0%	53.2%	
Higher Education Degrees in Bioscience Fields, AY 2004	2,189	111,329	19
Bioscience Occupations in the Workforce, 2004	19,190	616,140	11