

NEW YORK STATE'S TECHNOLOGY-DRIVEN INDUSTRIES: BIOTECHNOLOGY AND PHARMACEUTICALS

Summary

The biotechnology and pharmaceutical industries are among the most research and development intensive in the United States. Changes in demographic characteristics have increased the demand for products that remedy or alleviate medical problems associated with aging, while rapid advances in knowledge of underlying biological and chemical processes have resulted in a revolution in the development of medical diagnostics and treatments.

New York's exceptional research infrastructure has contributed to the state's strong position in the bio/pharma industry. New York ranks second in the nation in biological research and development expenditures at universities (\$1.882 billion) in 2002, with two universities in the top 20 in the nation, and 11 in the top 100. Similarly, the state is a leader in industrial pharmaceutical research, with \$705 million in industry spending, ranking fourth nationally.

All this has contributed to a large and vital industry within the state. 2001 data shows that 1,895 establishments across New York State employed 41,190 workers. New York's bio/pharma employment is about 7.1% of the national total.

The bio/pharma industry cluster is found in locations throughout New York State. While 28% of the state's bio/pharma employment is located on Long Island, a majority of regions in the state have greater than expected concentrations of employment compared to the nation, including the Capital Region (Albany-Schenectady-Troy), Central New York (Syracuse), Long Island, the Mid-Hudson region (Westchester County), the North Country and Western New York (Buffalo-Niagara Falls).

The Bio/Pharma Industry

Biotech is sometimes referred to as a "first cousin" to pharmaceuticals; many biotech companies serve as first-stage R&D arms of pharmaceutical companies. The biotech field itself is unique in

that the industry is not defined by its products, but by the technologies used to make those products. The technologies have been used primarily by the pharmaceutical industry but are increasingly being used by other industries such as agriculture, mining, waste treatment, food processing, and others.

According to the Biotechnology Industry Organization there were 1,466 biotechnology companies in the United States in 2003, with revenues of \$29.6 billion, and employment of 194,600. In the United States, pharmaceutical companies employ more than 219,000. Among the large pharmaceutical companies headquartered in New York are Pfizer and Bristol-Myers Squibb. Several large manufacturers of generic drugs are located in the state as well, including Forest Laboratories, Par Pharmaceuticals, and Del Laboratories.

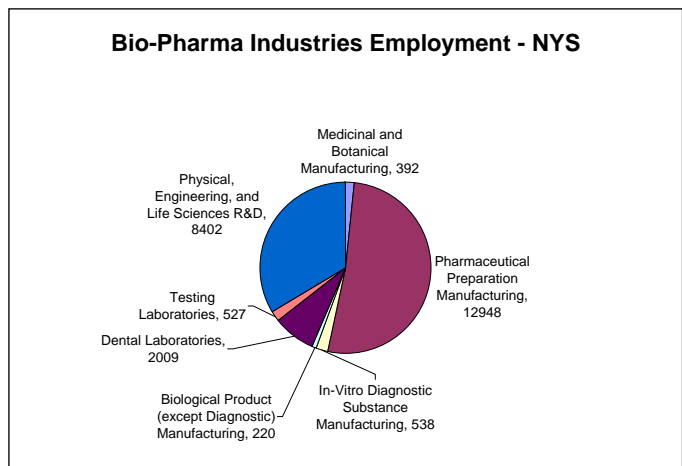
The pharmaceutical and biotechnology industries are among the most research and development dependent of any sector of the economy. The National Science Foundation reports that in 2001, that companies in the pharmaceutical and medicine industry spent \$10.1 billion on company funded R&D, ranking fourth behind motor vehicles, communications equipment and semiconductors and electronic components.

The biotechnology and pharmaceutical industries are part of New York State’s larger biomedical cluster. Empire State Development defines the bio/pharma sector to include all or part of the following industries:

NAICS Code	Name
325411	Medicinal and Botanical Manufacturing
325412	Pharmaceutical Preparation Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
339116	Dental Laboratories
541380	Testing Laboratories
541710	Research and Development in the Physical, Engineering, and Life Sciences

The Bio/Pharma Industry in New York State

Overall New York State employment in 2001 for all bio/pharma firms was 41,190. These bio-pharma employees worked at 1,890 establishments. New York is home to operations of many leading pharmaceutical companies, including Pfizer, Bristol-Myers Squibb, Wyeth Labs, Sanofi-Synthelabo, Bayer, Bausch & Lomb and Novartis. A number of other major pharmaceutical companies have locations here as well, including Celltech, Forest Labs, Del Labs, Twin Labs, NBTY and Barr. The state has seen significant growth in the number of

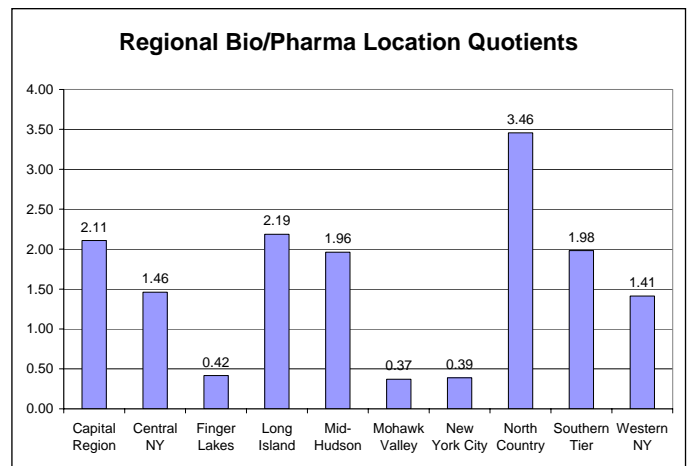
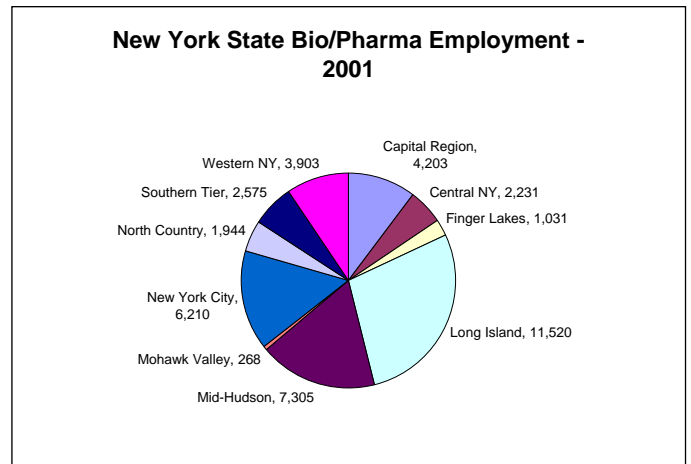


biotech firms, such as Danisco USA, Albany Molecular Research, ImClone Systems, Genencor and Regeneron.

Location quotients (LQ's) compare the relative concentration of employment in an industry within a particular state or locality with that found in the nation. An LQ of one indicates a concentration of workers equal to that found nationally. Compared to the nation's overall labor force, New York has more workers in the areas of pharmaceutical preparation manufacturing (LQ=1.34) and research and development (LQ=1.14) than would be expected based on the state's population. These areas also have the greatest employment in the cluster.

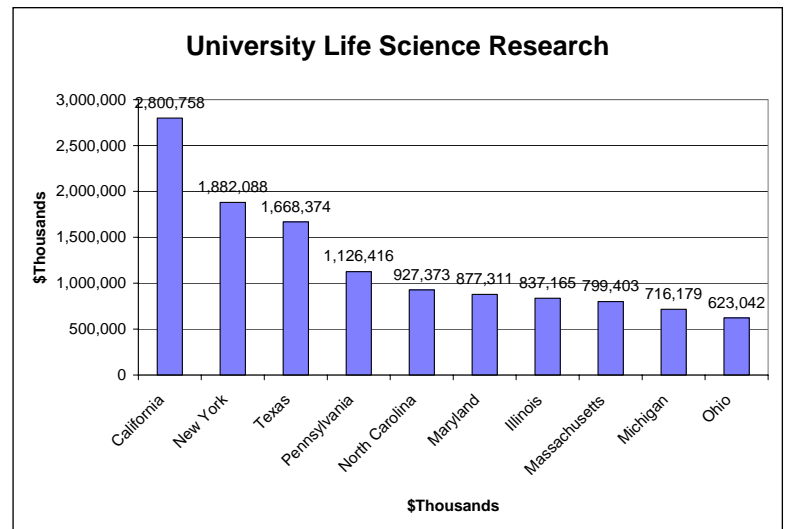
Firms manufacturing pharmaceutical preparations in New York State employed 12,948 in 2001, while those in research and development employed 8,402.

ESD obtained data on employment at bio/pharma companies from the New York State Department of Labor's unemployment insurance employment database (ES202 series). The data shows that bio-pharma employment is greatest on Long Island (11,520 employees), followed by the Mid-Hudson region (primarily Westchester County – 7,305 employees). A number of New York regions had greater concentrations of employment in 2001 in bio-pharma than would be expected from national level employment patterns. These included the Capital Region (Albany, Schenectady, Troy - LQ=2.11), Central New York (Syracuse - LQ=1.46), Long Island (LQ=2.19), the Mid-Hudson region (Westchester County - LQ =1.96), the North Country (LQ+3.46), the Southern Tier (Binghamton, Elmira - LQ=1.98), and Western New York (Buffalo, Niagara Falls - LQ=1.41).



Research and Development Expenditures

New York has a strong concentration of institutions performing significant amounts of biological research. The National Science Foundation's *Survey of Research and Development Expenditures at Universities and colleges, Fiscal Year 2002* shows that across the nation, higher education institutions spent a total of \$21.198 billion on research and development in the life-sciences. New York ranked second nationally, with \$1,882,088 in life-science R&D, behind only California. New York has two of the top 20 and 11 of the top 100 universities in biological research and development spending. Spending at these top New York State academic biological research institutions totaled \$658.4 million on R&D for biological sciences – 10% of the U.S. total.



In 2002, New York City's Rockefeller University ranked fourth nationally in biological research and development spending among colleges and universities, with expenditures of \$150.6 million. Also in the top 25 are New York City's Columbia University, with \$101.8 million in biological R&D, and Cornell University with \$70.3 million. Other New York institutions in the top 100 for biological R&D spending in 2002 were:

- Mt. Sinai School of Medicine -- \$64.6 million
- SUNY Stony Brook -- \$51.1 million
- SUNY Buffalo -- \$50.5 million
- New York University -- \$48.9 million
- University of Rochester -- \$46.4 million
- Yeshiva University -- \$38 million
- SUNY Albany -- \$35.2 million
- SUNY Health Science Center (Brooklyn) – \$20.6 million
- New York Medical College -- \$17.4 million

The most recent available data concerning industrial spending for research and development is for the year 2000. Available data shows that companies manufacturing pharmaceuticals and medicines spent \$705 million on R&D in New York State, fourth highest among the top ten R&D performing States. Only New Jersey, Pennsylvania and Illinois ranked higher than New York in industrial R&D spending by pharmaceutical and medicine manufacturers.

CAPITAL REGION (Albany-Schenectady-Troy)

In 2001, 122 establishments in the Capital region employed 4,203 workers in the bio/pharma industry. The region showed the third greatest regional specialization in bio/pharma of any part of the state (after the North Country and Long Island) with 2.1 times the employment that would be expected based on national level patterns.

Capital Region	
Establishments	122
Employees	4203
Location Quotient	2.11

Supporting Resources

The NSF reports that the State University at Albany had biological research and development expenditures of \$35.2 million in 2002, placing it 73rd nationally among universities and colleges. Albany Medical College had \$13.1 million in spending on life sciences R&D in that year. 21 graduates of SUNY Albany, Rensselaer Polytechnic Institute and Albany Medical College received doctoral degrees in biology in 2002.

The New York State Health Department's Wadsworth Center, based in Albany, employs 1,200 people. It is the most comprehensive state health laboratory in the nation. It has core programs in biology, immunology, genetics, imaging and molecular structure.

Albany Medical College is one of the nation's oldest private medical schools. The college provides education of health care personnel, research in the basic and clinical medical sciences, and patient care services.

Institutions of higher education in the Capital region offering relevant academic programs include:

Discipline	Institutions
Biological and Physical Sciences	Adirondack Community College Columbia-Greene Community College Hudson Valley Community College Rensselaer Polytechnic Institute Sage Junior College of Albany Schenectady County Community College SUNY Empire State College Union College
Biology	Adirondack Community College The College of St. Rose Regents College Rensselaer Polytechnic Institute Russell Sage College Siena College Skidmore College SUNY Albany Union College
Molecular Biology	SUNY Albany
Pharmacy	Albany College of Pharmacy of Union University

Significant Regional Bio/Pharma Companies

- Albany Molecular Research, Inc.
- Fortitech, Inc.
- Organichem, Inc.

CENTRAL NEW YORK (Syracuse)

In 2001, 87 establishments in the Central New York region employed more than 2,200 workers in the bio/pharma industry. The region showed a strong concentration of bio/pharma employment, with about 50% more employment than would be expected based on national level employment patterns.

Central NY	
Establishments	87
Employees	2231
Location Quotient	1.46

Supporting Resources

National Science Foundation data shows that the **SUNY Health Sciences Center in Syracuse** had \$6.1 million in biological research and development spending in 2002. SUNY Health Sciences and the **SUNY Environmental Science Center** (also in Syracuse) graduated 27 with doctoral degrees in biological science in 2002.

Institutions of higher education offering relevant academic programs include:

Discipline	Institutions
Agricultural Sciences	SUNY College of Agriculture and Technology at Morrisville
Biological and Physical Sciences	LeMoyne College SUNY College of Environmental Science & Forestry Fulton-Montgomery Community College Herkimer County Community College Mohawk Valley Community College Onondaga Community College SUNY College of Agriculture and Technology at Cobleskill
Biological Technology	SUNY College of Agriculture and Technology at Morrisville
Biology	Colgate University LeMoyne College SUNY Oswego SUNY College at Cortland SUNY College of Agriculture and Technology at Morrisville SUNY College of Environmental Science and Forestry at Syracuse University Wells College Fulton-Montgomery Community College Hamilton College

	Herkimer County Community College Mohawk Valley Community College SUNY College of Agriculture and Technology at Cobleskill Utica College of Syracuse University
Biotechnology Research	SUNY College of Environmental Science and Forestry
Molecular Biology	Colgate University Wells College

Significant Regional Bio/Pharma Companies

- Bristol-Myers Squibb
- Hanford Manufacturing Company

LONG ISLAND

In 2001, 446 Long Island bio/pharma companies employed 11,520 people. The region is host to outstanding scientists, major research advances, and a vital bio/pharma industry. The region showed a significant regional specialization, with about 2.2 times more employment in the industry than would be expected from national employment patterns.

Long Island	
Establishments	446
Employees	11520
Location Quotient	2.19

Supporting Resources

The **State University of New York at Stony Brook** is a national leader in biotechnology research and development. With \$51.118 million in biological science research and development spending in 2002, SUNY Stony Brook ranked among the top 50 universities in the nation. SUNY Stony Brook graduated 45 Ph.D.'s in the field in 2002. SUNY Stony Brook's Center for Biotechnology has fostered the development of a comprehensive infrastructure to support the bio/pharma industry cluster in New York State. Chief among its accomplishments has its role in the creation of the Long Island High Technology Incubator (LIHTI) and the New York Biotechnology Association (NYBA). The LIHTI program was established by the Center in response to the demand by start-up bio/pharma companies for affordable lab space and research services. NYBA is a statewide non-profit trade association with 260 members, working to ensure a favorable economic and regulatory environment for the bio/pharma industry in the State.

The **Brookhaven National Laboratory's** unique facilities are used to develop new applications of nuclear technology and to understand the effects of energy-related agents on human health. Researchers aim to understand genetic and biochemical processes at the molecular level. The **Cold Spring Harbor Laboratory** has become a world center for the study of molecular events that occur when a normal cell becomes cancerous. Research into the causes of cancer as well as the study of neurobiology of the brain remain the focus of the Laboratory's research programs.

Long Island is the location of two business incubators specializing in biotechnology: SUNY Farmingdale (SUNYF)/Cold Spring Harbor Laboratories (CSHL) Biotech R&D Park and the North Shore University Hospital Biotechnology Incubator. SUNYF and CSHL formed a strategic alliance

to create a new biotech facility on 20 dedicated acres of the SUNY Farmingdale campus. The North Shore University Hospital is renovating an existing building to create a state-of-the-art biotech incubator focusing on biomedical product development.

Institutions of higher education in the region offering relevant academic programs include:

Discipline	Institutions
Biological and Physical Sciences	Dowling College Hofstra University Suffolk County Community College
Biology	Adelphi University Dowling College Hofstra University Long Island University – C. W. Post Campus Long Island University – Southampton Campus Molloy College New York Institute of Technology St. Joseph’s College – Suffolk SUNY Stony Brook SUNY College at Old Westbury Suffolk County Community College Wagner College
Biomedical Engineering – Related Technology	SUNY Farmingdale
Molecular Biology	Long Island University – C. W. Post Campus
Pharmacology	SUNY Stony Brook
Pre-Pharmacy Studies	Long Island University – C. W. Post Campus

Significant Regional Bio/Pharma Companies

- E-Z Em, Inc.
- Loxottica USA, Inc.
- Pall Corporation
- Spectronics Corp.

MID HUDSON REGION

In 2001, 253 businesses in the Mid-Hudson region employed 7,305 workers in the bio/pharma industry. The region showed a significant regional specialization in bio/pharma, with nearly twice as much employment in the industry as would be expected based on national employment patterns.

Mid-Hudson	
Establishments	253
Employees	7305
Location Quotient	1.96

Supporting Resources

The Mid-Hudson region has a highly diversified economy which includes a concentration in bio/pharma. Known for high technology, the region supports a strong concentration of scientists, engineers, physicists, and chemists working at a number of major industrial research laboratories.

New York Medical College in Valhalla is among the nation's largest private health sciences universities. More than \$25 million in research in the life sciences was ongoing at the college in 2002. In 2002, New York Medical College spent \$17.4 million on biological research and development, ranking it among the top 100 colleges and universities in the nation. The college produced 8 doctoral level graduates in biology in that year. Its Technology Development Division has helped to expand basic and clinical research through collaborations with the bio/pharma community.

Institutions of higher education in the region offering relevant academic programs include:

Discipline	Institutions
Biological and Physical Sciences	Bard College Dutchess Community College Marymount College Orange County Community College Rockland Community College Sarah Lawrence College Sullivan County Community College Ulster County Community College US Military Academy Westchester Community College
Biological Technology	Manhattan College
Biology	Bard College College of Mount Saint Vincent Concordia College Dominican College of Blauvelt Iona College Manhattan College Manhattanville College Marist College Marymount College Mercy College Mount Saint Mary College Orange County Community College SUNY Purchase St. Thomas Aquinas College Sarah Lawrence College SUNY New Paltz Sullivan County Community College US Military Academy Vassar College
Molecular Biology	Bard College
Pharmacy	Westchester Community College

Significant Regional Bio-Pharma Companies

- Bayer Diagnostics
- Novartis
- Wyeth
- Barr Laboratories
- Regeneron
- Par Pharmaceuticals

NEW YORK CITY

Bio/Pharma Employment

In 1997, 524 establishments in New York City employed 6,210 workers in the bio-pharma industry. New York is home to several bio/pharma companies, including Bristol-Myers Squibb and Pfizer.

New York City	
Establishments	524
Employees	6210
Location Quotient	0.39

Supporting Resources

New York City is a global center for technology. The City is home to some of the nation's top research universities and medical schools, and had seven of the top 100 university centers in R&D spending in 2002, according to the National Science Foundation.

Rockefeller University ranked fourth nationally in biological R&D spending, with \$150.5 million. The University graduated 30 students in the biological sciences at the doctoral level in 2002. The University specializes in research in the biological sciences, including areas such as geochemistry, structural geology and chemistry, immunology and microbiology, medical sciences and human genetics, molecular, cell and developmental biology, and neuroscience.

Columbia University had more than \$101 million in biological research in 2002. In that year, Columbia ranked 12th in the nation in biological research expenditures. The University graduated 57 biological science students at the Doctoral level in 2002.

Memorial Sloan-Kettering Cancer Center is frequently ranked as the top cancer center in the nation. MSKCC's research activities are organized into seven research programs: molecular biology, cell biology, cellular biochemistry and biophysics, immunology, molecular pharmacology and therapeutics, clinical research and cancer prevention and control.

Founded in 1898, and affiliated with the New York Hospital since 1927 and New York Presbyterian Hospital since 1998, **Weill Medical College of Cornell University** (formerly known as Cornell University Medical College) is among the top ranked clinical and medical research centers in the country. The Medical College is divided into twenty academic departments, focusing on clinical medicine; the study treatment and prevention of human diseases; and maternity care. **Cornell University** has PH.D. programs in biomedical research and education at the Weill Graduate School of Medical Sciences, and with neighboring Rockefeller University and the Sloan Kettering Institute (both in NYC). Weill Medical College and Graduate School maintains major affiliations with Memorial Sloan-Kettering Cancer Center, Hospital for Special Surgery, as well as the metropolitan area institutions that constitute the New York Presbyterian Health Care Network. The University, according to NSF spent more than \$70 million on biological research, ranking 23rd in the nation. Cornell's medical campus graduated 33 in the biological sciences with a Ph.D. degree in 2002.

Mount Sinai School of Medicine/Medical Center had more than \$64 million in biological research in 2002, ranking 29th nationally in biological research spending. The Center graduated 35 in the biological sciences with a Ph.D. degree in 2002.

Yeshiva University had \$38 million in biological research in 2002, ranking 69th nationally. Yeshiva graduated 37 students with the Ph.D. in biology in 2002. The University's Albert Einstein College of Medicine is a major teaching and research center in the field.

The State University of New York Health Science Center in Brooklyn is another significant center of teaching and research within the City's borders. According to the National Science Foundation, SUNY Health Science had \$21 million in biological research in 2002, graduating 13 Ph.D.'s in biological science in that year.

The **Audobon Biomedical Science and Technology Park**, an incubator facilitating industry-university collaboration, is located on the campus of Columbia University.

Discipline	Institutions
Biological and Physical Sciences	CUNY – Manhattan Community College Fordham University Long Island University – Brooklyn CUNY – Medgar Evers College Pace University
Biological Technology	CUNY – York College
Biology	Barnard College CUNY – Bronx Community College CUNY – Brooklyn Community College CUNY – City College CUNY – College of Staten Island Columbia College Columbia University Fordham University CUNY – Hunter College CUNY – Kingsborough Community College CUNY – Lehman College Long Island University – Brooklyn Marymount Manhattan College CUNY – Medgar Evers College New York University Pace University CUNY – Queensborough Community College CUNY – Queens College St. Francis College St. John's University St. Joseph's College Tuoro College Yeshiva University CUNY – York College
Biomedical Science	CUNY – City College St. Francis College
Molecular Biology	Long Island University – Brooklyn
Pharmacy	Long Island University – Brooklyn St. John's University

North Country

Bio/Pharma Employment

In 2001 45 establishments in the North Country employed more than 1,944 workers in the bio/pharma industry. The North Country showed the greatest regional specialization of any part of the state, with three and one-half times more employment in the industry than would be expected from national level data.

North Country	
Establishments	45
Employees	1944
Location Quotient	3.46

Supporting Resources

Clarkson University is located in Potsdam. The University offers undergraduate, graduate and doctoral programs in science. Its Department of Biology's current strength is biochemistry and molecular biotechnology. Clarkson is among the nation's best national universities and has one of the best undergraduate engineering programs in the nation, according to U. S. News and World Report.

Institutions of higher education in the region offering relevant academic programs include:

Discipline	Institutions
Biological and Physical Sciences	Clinton Community College Jefferson Community College North Country Community College SUNY College of Technology at Canton
Biology	Clarkson University SUNY Plattsburgh St. Lawrence University SUNY College at Potsdam SUNY College of Technology at Canton
Biotechnology Research	Clarkson University
Cell Biology	Clarkson University

Significant Regional Bio/Pharma Companies

- Wyeth Laboratories
- Upstate Biotechnology, Inc.

Southern Tier (Binghamton, Elmira, Ithaca)

Bio/Pharma Employment

In 2001, 2,575 workers were employed in the Southern Tier at 94 establishments in the bio/pharma industry cluster. The region's concentration of employment in bio/pharma was high – nearly twice the employment that would be expected from national level employment patterns.

Southern Tier	
Establishments	94
Employees	2575
Location Quotient	1.98

Supporting Resources

New York State supports the **Center for Advanced Technology (CAT) – Biotechnology Program at Cornell University**, which focuses on agriculture, the environment, food science and nutrition, and health care. The CAT defines biotechnology not as an industry, but as a set of tools that can be utilized by a wide range of industries for new and improved products and processes, the creation and expansion of markets, and competitiveness in the global marketplace. According to NSF, Cornell University spent nearly \$70 million on research and development in the agricultural sciences in 2002.

The New York State Agricultural Experiment Station in Geneva conducts research and extension on fruit and vegetable crops, a \$2 billion industry. Research covers crop production, protection and processing utilizing classical techniques and biotechnology. The station has about 130 active research projects under study by its 50 project leaders and more than 250 support staff.

Initiated through the Hatch Act of 1887 that established federal funding for agricultural research, the Cornell University Agricultural Experiment Station in Ithaca provides the fundamental knowledge and research base to sustain agriculture and food production throughout new York State and to contribute to the State's share of the national agricultural research program. The Cornell Ag Station covers research from basic biological science to applied agricultural research in plant, animal and physical sciences. There are more than 1,200 active projects in diverse areas such as soil, water and forestry, crops, animals, economics and agricultural policy, people and social institutions, food and human nutrition, and biotech.

Boyce Thompson Institute for Plant Research, Inc. is a private, independent nonprofit corporation affiliated with Cornell University. The Institute seeks to increase the understanding of plants and associated organisms for improved quality of human life. The Institute has four programs: Plant Molecular Biology; Plant Environmental Biology; Plants and Human Health; and Plant Protection.

Institutions of higher education in the region offering relevant academic programs include:

Discipline	Institutions
Agricultural Sciences	Cornell University
Biological and Physical Sciences	Corning Community College Tompkins Cortland Community College

Biological Technology	SUNY College at Oneonta
Biology	Cornell University Elmira College Hartwick College Ithaca College SUNY Binghamton SUNY College at Oneonta
Biometrics	Cornell University
Cell Biology	Cornell University

- Proctor & Gamble Pharmaceuticals
- DMV International Nutritionals

Western New York (Buffalo – Niagara Falls)

Bio/Pharma Employment

In 2001, 178 establishments in Western New York employed nearly 4,000 workers in the bio/pharma industry cluster. The region showed a high regional specialization, with about 1.4 times the number of employees that would be expected based on national level employment data.

Western NY	
Establishments	178
Employees	3,903
Location Quotient	1.41

Supporting Resources

Roswell Park Cancer Institute is the nation's first comprehensive cancer treatment, research, and education facility and a National Cancer Institute-designated comprehensive cancer center. This year, Roswell Park investigators were awarded major research grants and contracts totaling more than \$75 million. The Institute has sponsored or collaborated on more than 350 clinical trials of promising new cancer treatments.

SUNY – Buffalo offers a number of graduate and undergraduate programs in the biological and medical sciences, and is closely affiliated with Roswell Park Cancer Institute. The National Science Foundation reported more than \$50 million in biological research and development spending at SUNY-Buffalo in 2002, ranking it 52nd in the nation. SUNY – Buffalo granted 28 doctoral degrees in the biological sciences in 2002.

The University of Buffalo Foundation Incubator is a cooperative effort of the University and the areas Technology Development Council. It is designed to nurture the establishment of new, technology-intensive, high growth businesses in the region.

The University of Buffalo Center of Excellence in Bioinformatics merges high end technology, including supercomputing and visualization with expertise in genomics, proteomics and bio-imaging to enable major contributions to science and health care.

Institutions of higher education in the region offering relevant academic programs include:

Discipline	Institutions
Agricultural Sciences	SUNY College of Technology at Alfred
Biological and Physical Sciences	Alfred University Erie Community College Houghton College Jamestown Community College Niagara County Community College SUNY College at Fredonia SUNY College of Technology at Alfred
Biological Technology	Niagara University SUNY College at Fredonia SUNY College of Technology at Alfred
Biology	Alfred University Canisius College Daemon College D'Youville College Houghton College Niagara University St. Bonaventure University SUNY Buffalo SUNY College at Buffalo
Biomedical Science	SUNY College at Fredonia
Pharmacy	SUNY Buffalo