

# **Supply and Demand of Human Capital for the Biosciences Industry**

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## Table of Contents

Executive Summary .....	1
Introduction.....	5
Importance of Bioscience Talent .....	6
Scope of Work .....	7
What Is Bioscience: A Definition .....	8
National Bioscience Employment Cluster Analysis .....	10
Clustering and Science- and Technology-Driven Development .....	11
Half of Georgia’s Bioscience Employees Work in Metro Atlanta .....	11
New York, Boston, Los Angeles, San Francisco Have the Most Bioscience Employees.....	12
San Francisco, New York, and Boston Are the Most Concentrated.....	12
Albuquerque, Raleigh-Durham, and Knoxville Are Highly Specialized .....	14
Atlanta Has Balanced Employment Across Major Bioscience Subindustries.....	14
Large National Clusters Concentrate in Pharmaceuticals and R&D Subindustries .....	16
Future Demand for Bioscience Employees.....	18
Short-Term Demand .....	19
Long-Range Projections .....	23
Conclusions.....	25
Shortfall Analysis .....	27
Shortfall Analysis: Four Components.....	28
There Are Few Large Bioscience Shortfalls Distinguishable from the Health Care Sector....	31
Conclusion .....	32
Wage Analysis .....	34
Wage Analysis Issues and Methods.....	35
Core Bioscience Salaries in Georgia Are Slightly Below National Benchmarks.....	35
Conclusions.....	36
Executive Interviews.....	37
Introduction and Method .....	38
Experience Is of More Interest Than Education, Particularly to Start-up Companies .....	38
Shortages Were Reported Across Diverse Clinical and Scientific Bioscience Occupations ..	39
Recruitment Is Hampered by a Lack Bioscience Company Critical Mass.....	39
Georgia Bioscience Salaries Are Perceived to Be Competitive .....	40
More Should be Done to Publicize Georgia’s Biotech Strengths.....	41
Summary and Recommendations .....	42
References.....	46
Appendix I. Methodology for Short and Long-term Demand Analysis .....	48
Appendix II. Short-Term Demand: Detailed Occupational Titles.....	52
Appendix III. Companies in the metro Atlanta and state bioscience directories advertising job openings in January 2003 .....	55
Appendix IV. Mean Wages by Bioscience Occupation: Georgia and U.S.....	57
Appendix V. Executive Interview Protocol.....	59

## **List of Figures**

Figure 2.1. Map of Bioscience Employment by Georgia County.....	13
Figure 2.2. Map of Bioscience Employment for Top MSAs With At Least 5,000 Bioscience Employees.....	13
Figure 2.3. Map of Spatial Concentration: Bioscience Employment per Square Mile .....	15
Figure 2.4. Map of Specialization: Bioscience Employment as a Percentage of Total Employment.....	15
Figure 2.5. Bioscience Sector Profile: Atlanta Compared to Other Southern MSAs .....	17
Figure 2.6. Bioscience Sector Profile: Atlanta Compared to Large National Clusters .....	17
Figure 3.1. Nearly Half the Life Science Job Openings in Georgia Involve Research/Scientific Positions or Finance/Marketing/Sales .....	20
Figure 3.2. Two-thirds of Bioscience Job Openings Require at Least a Bachelor's Degree .....	21
Figure 3.3. Only 10 Percent of Bioscience Job Openings Require Less Than a Year of Experience .....	22

## **List of Tables**

Table 1.1. NAICS-based Bioscience Industry Definition Used in This Study .....	9
Table 3.1. Management/Administration/Licensing and Scientific/Research Positions Require More Experience Than Other Life Sciences Positions .....	22
Table 3.2. Fastest-Growing Bioscience Occupations Projected Through 2010: .....	24
Largest Number of New Jobs and Fastest Growing in Georgia and United States .....	24
Table 4.2. Bioscience Classification of Instructional Programs .....	30
Table 4.3. Shortfall Analysis of Georgia Bioscience Occupations with at least 40 Annual Openings 2000-2010 .....	33

# **Executive Summary**

Georgia has a dynamic bioscience sector of more than 14,000 employees, half of whom work in Atlanta. Now that a foundation of bioscience-related employees has been developed, what must Atlanta and the state do to prepare for future bioscience employment needs?

The objective of this study, sponsored by the Intellectual Capital Partnership Program (ICAPP) of the University System of Georgia (USG), was to gauge current and future bioscience employment needs. The study addressed this objective by assessing projected demand for workers in bioscience occupations through 2010 relative to the supply of graduates of postsecondary institutions and workers moving into the state. National trends in employment and wages were compared to Georgia statistics. Most significant, interviews with bioscience executives were important in interpreting the data and formulating recommendations:

## Findings

The key findings of this study were as follows:

- Two-thirds of all current job openings as listed on Web sites of existing bioscience companies in the state require at least a bachelor's degree
- More than 90 percent of job openings require some industry relevant experience.
- Georgia's top 15 bioscience-related occupations with the largest number of jobs projected from 2000-2010 are very similar to those of the nation.
- There is a current and future need for life science research capabilities in Georgia. Today about one-quarter of all bioscience job advertisements are for researchers and scientists. From 2000 to 2010, the demand for biochemists and biophysicists, medical scientists, and biomedical engineers is projected to increase by at least 50 percent
- Overall, the analysis does not find that there are significant shortfalls. Due to the difficulties in analyzing publicly available data and the apparent overlap between bioscience and health care occupations, the state should continue to track the needs of companies in this industry. An ongoing deficit of technicians and technologists is apparent and warrants monitoring. There may be sufficient supply today, but if Georgia persists in turning out small numbers of graduates relative to the larger numbers of openings, this deficit could result in a future economic development bottleneck
- The industry is at the national pay scale for senior talent. Wage differentials do exist between

Georgia and the nation. Average bioscience wages in Georgia are below national averages, particularly for technician level occupations.

- Bioscience firm recruitment is hampered by a lack of critical mass of similar companies in the state.
- Many bioscience firms did not think of colleges and universities as a source of talent. They do not actively recruit at universities. Industry reports that their biggest source for employees is other bioscience companies. Universities should do more to ensure that their graduates are getting attention.

## **Recommendations**

Based on these findings, the project team recommends the following:

- The biosciences industry is talent driven. Bioscience firms' human resource searches are driven by talent availability both from educational resources and existing companies. The USG should ensure that its institutions are positioned to support the advancement of this industry as it related to the supply of talent.
- For Georgia to be competitive in this industry in the future, the state should ensure that there is an adequate supply of graduates to serve employees in the following national high demand fields: medical and clinical laboratory technicians and technologists, chemists, biological and chemical technicians, biomedical engineers, biochemists and biophysicists, and medical scientists. Given the need for talent in the biosciences, those states that are able to build a supply of talent will be successful in supporting the growth of the industry.
- Companies in the bioscience industry seek experienced employees. University curriculum should be expanded to include experience, such as through certificate programs, to meet the needs of industry.
- Many of the skill sets in the biosciences are interdisciplinary in nature (regulatory affairs, for example). Departments and schools should be encouraged to work collaboratively to meet the needs of industry. In addition, an integrated approach between USG and the Georgia Department of Technical and Adult Education will best support the needs of industry for technicians and technologists.

- While data suggest that there is an adequate supply of talent in many areas, this is a dynamic industry and as the state moves to recruit industry and investments in GRA begin to bear fruit, this picture can change radically.



## **Section 1**

# **Introduction**

## Importance of Bioscience Talent

Scientific breakthroughs resulted in the 21<sup>st</sup> century being termed the age of bioscience. Bioscience advances are unleashing a new period of innovation. These advances are not just transforming genetics, bioengineering, medical devices, and related industries, they are also reshaping the basic premises of economic development.

Traditionally, natural resources and physical labor were the source of wealth creation and economic growth. Economic development success was obtained from having lower costs. Natural resource and raw material endowments, accessibility to transportation routes, the cost and productivity of physical labor, and the ability to optimize the overall costs of doing business produced a competitive edge in economic development. Firms sought to reduce their costs by selecting locations that had an optimal cost structure and business climate.

In the emerging bioscience economy, talent and ideas have become the decisive factor of social, economic, technological, and cultural transformation. Talent and associated ideas are important because they change traditional factors of production (i.e., human capital, physical capital, materials, energy, and management). The bioscience economy favors places that can mobilize the best people and capabilities.

The aim of this project is to better understand the demand for talent in Georgia's emerging bioscience economy. This is a particularly challenging goal because of the dynamism in the bioscience industry in the state and the nation. For the past two years, Georgia has ranked ninth in Ernst and Young's *2002 Global Biotechnology Report*. Georgia, along with other states, has made significant research, strategy, and marketing investments that suggest the biotech sector will see future growth. This future growth potential makes the need for understanding the demand for talent especially important.

The Intellectual Capital Partnership Program (ICAPP) of the University System of Georgia (USG) and the Metro Atlanta Chamber of Commerce (MACOC) assembled a group of local experts to address this need for understanding future demands for talent. The experts included representatives from the Georgia Biomedical Partnership, the Atlanta Regional Consortium for Higher Education (ARCHE), the Georgia Department of Technical and Adult Education's (DTAE) Quick Start program, The Life Sciences HR Xchange (a newly formed

human resource network), the student-run Atlanta Biotech Network, and economic development researchers from Georgia Tech's City Planning Program and Economic Development Institute.

The vision of this group is that Georgia in general, and Atlanta and surrounding areas in particular, has a talent environment that fosters bioscience development. Georgia's image should no longer be that of a Southeastern sales outpost, but rather a vibrant, research-driven bioscience center. Georgia should have sufficient experienced senior personnel and enough entry-level jobs within the state so students educated with Georgia resources do not have to go elsewhere to find jobs in the bioscience industry. Bioscience jobs pay competitive wages within the state. And any gaps in university and college curricula should be addressed quickly and with flexibility because of input from, and close partnerships with, indigenous bioscience industry.

## **Scope of Work**

To examine where Georgia is relative to this vision, Georgia Tech researchers conducted an assessment of the future demand for bioscience talent and current supply of talent within the state projected through 2010. The relatively new and dynamic nature of the bioscience industry necessitates that multiple methods be used to develop findings and recommendations. Researchers utilized five main methods, briefly summarized below.

### **National Bioscience Employment Cluster Analysis**

Because biosciences form a dynamic national industry, it is important to consider not just in-state information, but also employment in major metropolitan areas across the nation. Section 2 presents the results of this U.S. bioscience employment cluster analysis.

### **Future Demand for Bioscience Employees**

Demand analysis looks at new positions that must be filled according to state and national projections, both today and through 2010. The demand analysis appears in Section 3.

### **Shortfall Analysis**

Supply analysis examines the possible sources of talent to fill these new jobs, including college and university graduates as well as people with the appropriate occupational

qualifications moving into the state. Section 4 examines the sources of talent and the extent to which the state may face shortfalls in certain occupations that could result in economic development bottlenecks.

### **Wage Analysis**

Wage analysis assesses whether bioscience jobs in Georgia pay salaries that are competitive with national offerings. Section 5 presents bioscience occupational wage comparisons between Georgia and the nation.

### **Executive Information**

Quantitative information presented in the aforementioned sections is supplemented with qualitative information from interviews with large and small life sciences firms. Section 6 summarizes the results of these interviews.

### **Summary and Recommendations**

A discussion of the findings and implications for educational offerings and economic development approaches will appear in Section 7.

## **What Is Bioscience: A Definition**

The bioscience industry is difficult to define because of being relatively new and undergoing continuous business and scientific transformation. Publicly available data for U.S. counties employs conventional industry coding schemes—Standard Industrial Classification (SIC) and North American Industrial Classification System (NAICS) codes—which tend to be static and broad, i.e., they cannot always pinpoint bioscience-specific product lines. The Georgia Research Alliance and other bioscience institutions in the state have adopted the definition developed by Battelle Memorial Institute (Battelle) in its groundbreaking framework plan for Georgia (Battelle, 2002). Researchers considered bioscience industry definitions used in studies conducted for other cities (e.g., San Diego, San Francisco, Portland), states (e.g., Arizona, Virginia), and national organizations (e.g., the U.S. Biotechnology Industry Association, the

Office of Technology Policy, and the Brookings Institution). The decision was made to stick with the Battelle study definition.

The Battelle study used 14 SICs to defined bioscience industries. Since that study, most government data is produced using the NAICS system, which is designed to better pinpoint particular industries than SICs, especially knowledge-based industries such as biosciences. Based on the U.S. Census Bureau’s SIC-NAICS bridge, Georgia Tech researchers identified NAICS categories that are most closely associated with the Battelle SICs. Some industries that were clearly not biotech, but existed in the broader SIC categorization, were eliminated from the NAICS list, (e.g., manufacturing of certain paper products). Defined in this report, the bioscience industry includes drug, instrument, and surgical and medical equipment manufacturing as well as testing laboratories and research and development. (See Table 1.1 for NAICS list).

**Table 1.1. NAICS-based Bioscience Industry Definition Used in This Study**

<b>NAICS</b>	<b>Description</b>
325411	Medicinal and botanical manufacturing
325412	Pharmaceutical preparation manufacturing
325413	In-vitro diagnostic substance manufacturing
325414	Biological product (excluding diagnostic) manufacturing
334510	Electromedical apparatus manufacturing
334516	Analytical laboratory instrument manufacturing
334517	Irradiation apparatus manufacturing
339111	Laboratory apparatus and furniture manufacturing
339112	Surgical and medical instrument manufacturing
339113	Surgical appliance and supplies manufacturing
541380	Testing laboratories
541710	R&D in physical, engineering, and life sciences

## **Section 2**

# **National Bioscience Employment Cluster Analysis**

## **Clustering and Science- and Technology-Driven Development**

Bioscience industries, as with other science- and technology-driven sectors, are attracting attention in the way they locate in geographically proximate clusters. Organizations and firms that are geographically nearby most easily share information, knowledge, and human capital. (Krugman, 1991; Bergman and Feser, 1999) Likewise, regionally focused industry clusters that combine skills, infrastructure, and technology with sophisticated demand conditions, complementary services and suppliers, and local contexts encouraging investment and development continue to be associated with innovation capability and economic competitiveness. (Rosenfeld, 1992; Porter 2000, 2001) While the contribution and potential of the spatial clustering of technology-based companies is not a new field of study, it has attracted much attention in policy and economic development circles.

## **Half of Georgia's Bioscience Employees Work in Metro Atlanta**

This chapter examines concentrations bioscience employment in metropolitan statistical areas (MSAs) through a geographic information system (GIS) analysis. The analysis is based on *County Business Patterns* for 2000. Employment in the bioscience NAICS was assembled by county for all counties in the United States. For at least half of these counties, data was suppressed and only ranges were reported. When data was suppressed, researchers substituted the average employment for all counties across the country for which data was reported in the size classification. The substituted numbers generally were lower than the midpoints (the number substituted for the top employment category “100,000 or more employees” was 500,000). Researchers then aggregated county data to the MSA level to facilitate comparison between Atlanta and other major city clusters in the Southeast and the nation. To focus further on major city clusters and enhance comparability, researchers examined only MSAs with 5,000 or more bioscience employees. There are 35 MSAs with at least 5,000 bioscience employees.

Georgia has approximately 14,000 employees in bioscience industry codes (as of 2000). Half these employees work at establishments in the Atlanta MSA. Cobb County has the largest number of bioscience employees in metro Atlanta (more than 2,500), followed by Gwinnett County, with nearly 2,000. Augusta is the second largest bioscience MSA in terms of number of

employees, with nearly 2,500. DeKalb, Fulton, Dougherty, Chattooga, Habersham, Newton, Houston, and Madison counties have more than 500 bioscience employees apiece. (See Figure 2.1.) For the competitive analysis, only the Atlanta MSA is included because the other MSAs have fewer than 5,000 employees.

## **New York, Boston, Los Angeles, San Francisco Have the Most Bioscience Employees**

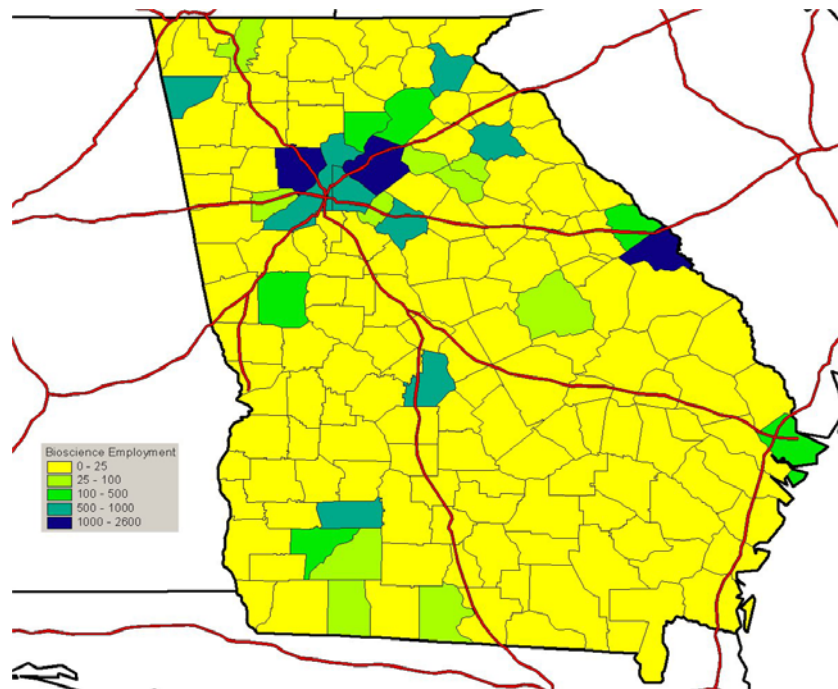
MSA bioscience clusters are examined three ways. The first is based on raw numbers of employees. (See Figure 2.2.) The largest cluster is the New York-New Jersey MSA, which has nearly 100,000 employees. Boston, Los Angeles, and San Francisco are in the second highest category, each city having more than 50,000 employees. In the South (excluding Washington, D.C.) Raleigh-Durham, Dallas-Ft. Worth, and Houston are the largest clusters, each of which has at least 15,000 bioscience employees. Atlanta's 7,000 MSA bioscience employment base is similar in size to the following Southern cities: Knoxville, Tampa, Austin, and San Antonio.

## **San Francisco, New York, and Boston Are the Most Concentrated**

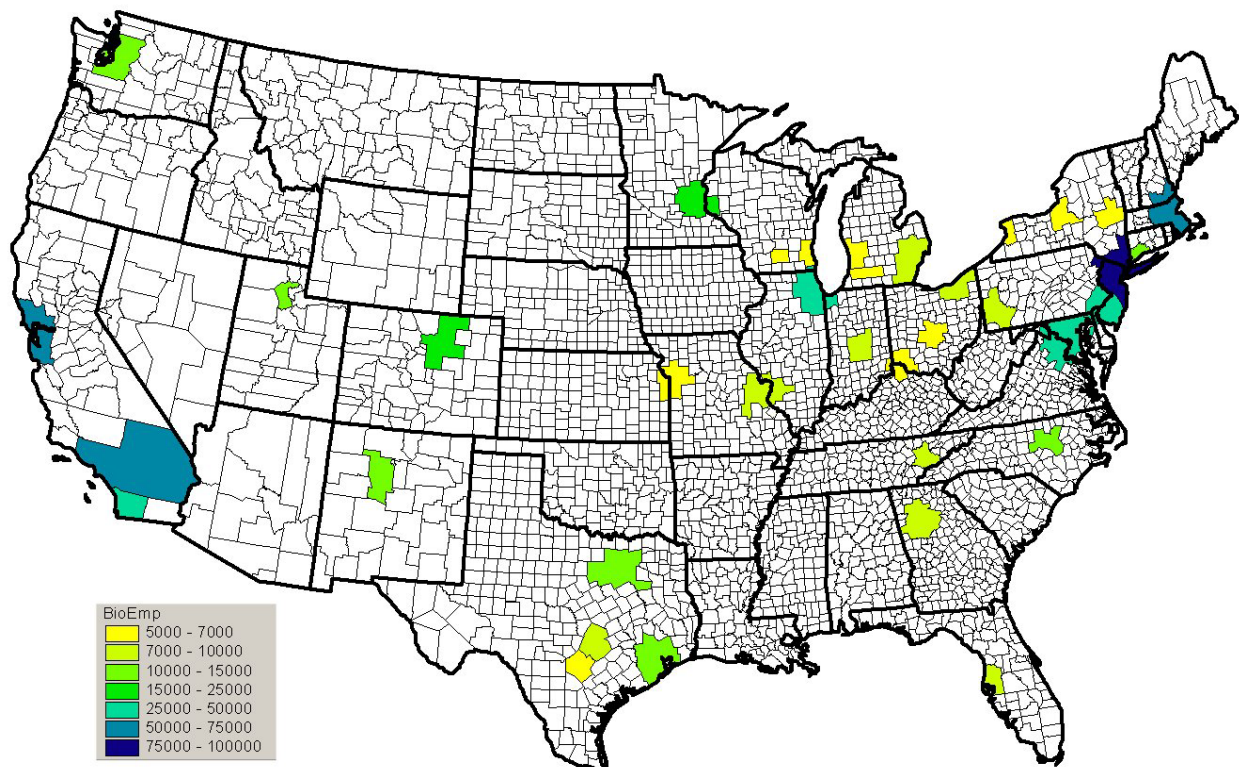
Just looking at the raw number of employees can be deceptive because MSAs differ considerably in land mass. Spatial concentration can be important in cluster development because companies that are geographically close together can more easily share employees, research, and other business factors. Researchers portray spatial concentration by dividing the raw number of employees by the number of square miles in the MSA. (See Figure 2.3.) San Francisco, New York, and Boston are the most spatially concentrated MSAs. Los Angeles drops into the lowest category (two or fewer bioscience employees per square mile) because its MSA boundary covers a big area. Georgia also is in the lowest category because its MSA also includes many counties that add square miles and residences but not additional bioscience employment.



**Figure 2.1. Map of Bioscience Employment by Georgia County**



**Figure 2.2. Map of Bioscience Employment for Top MSAs With At Least 5,000 Bioscience Employees**



## **Albuquerque, Raleigh-Durham, and Knoxville Are Highly Specialized**

A third way to analyze employment clusters is to determine how specialized they are in any given sector. An MSA may have many bioscience employees simply because the MSA has a large overall employment base. In a sense, specialization, calculated by dividing the target sector (biosciences) by the total number of employees, corrects for this. It measures how important a given sector is to the local economy. Figure 2.4 illustrates the degree of bioscience specialization by MSA. The biosciences industry is not as important to the local economy in Atlanta, where they accounts for less than 0.5% of overall MSA employment. In contrast, nearly 8 percent of Albuquerque's employees work in biosciences. In the South, Knoxville and Raleigh-Durham have 2 to 4 percent of their employment in biosciences, indicating they are more specialized than Georgia.

## **Atlanta Has Balanced Employment Across Major Bioscience Subindustries**

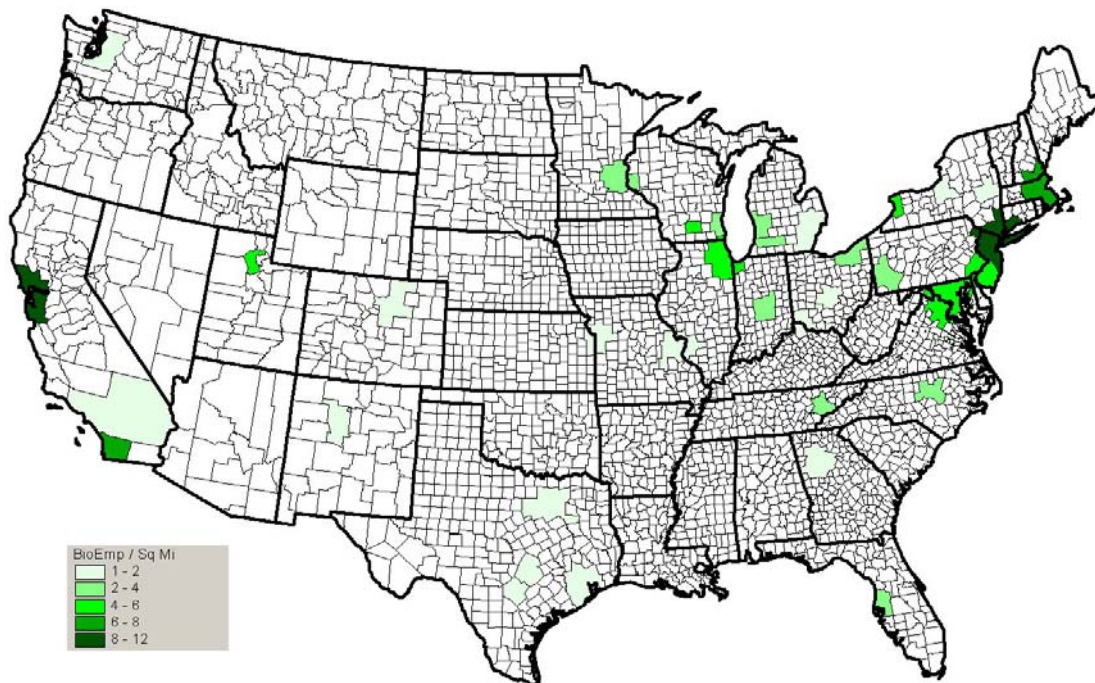
The GIS analysis treated bioscience as a single industry. However, the bioscience industry is really made up of many smaller subindustries. Researchers took the 12 NAICS codes in the definition and grouped them into five subindustries:

1. Pharmaceuticals manufacturing
2. Research and development (R&D)
3. Medical instrument manufacturing
4. Medical and surgical equipment manufacturing
5. Testing laboratories.

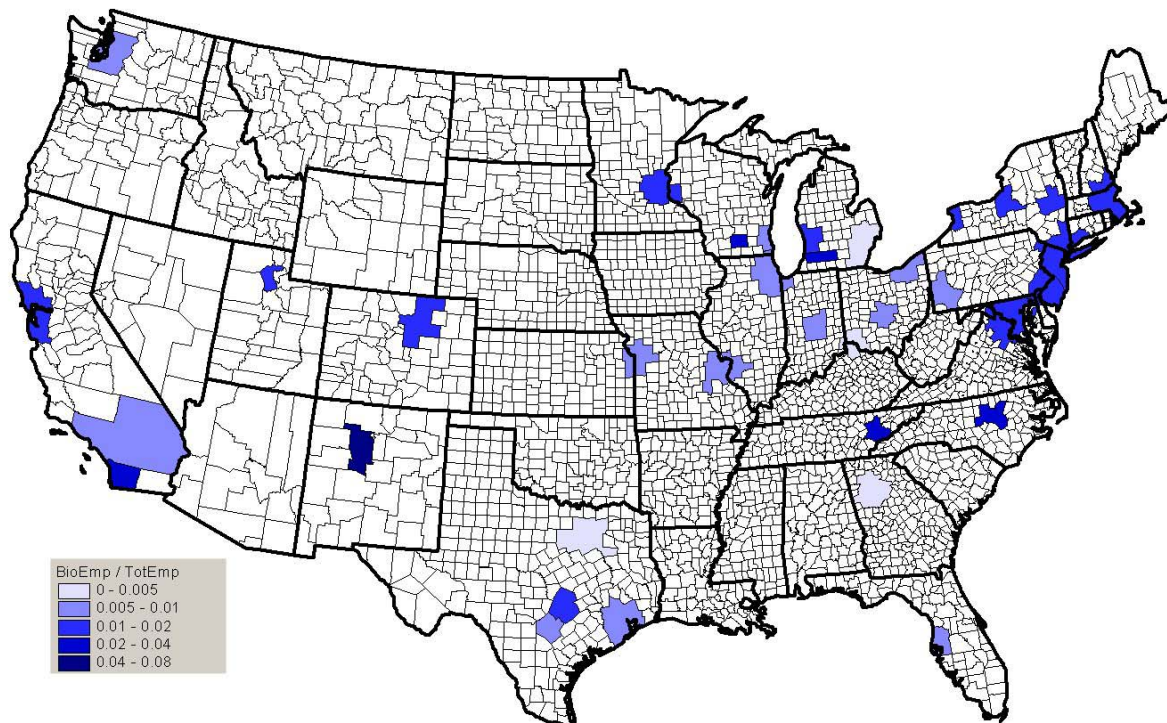
For a given MSA, researchers asked what percentage of its bioscience employment was in each of these subindustries. The percentages must add to 100 percent, so if an MSA has a high percentage in one subindustry, it necessarily must have a lower percentage in another.

Figure 2.5 compares Atlanta and other MSAs in the South having at least 5,000 bioscience employees. Atlanta's bioscience employment does not exceptionally concentrate in any one subindustry—it is relatively balanced across all five subindustries. Some of the other regional cities do exhibit more subindustry concentration. For example, Knoxville and San

**Figure 2.3. Map of Spatial Concentration: Bioscience Employment per Square Mile**



**Figure 2.4. Map of Specialization: Bioscience Employment as a Percentage of Total Employment**



Antonio have over 60 percent of their employment in R&D, compared with about 30 percent for Atlanta. Raleigh-Durham, Tampa, Dallas, and Austin have 30 percent of their employment in pharmaceuticals compared to just over 10 percent for Atlanta.

## **Large National Clusters Concentrate in Pharmaceuticals and R&D Subindustries**

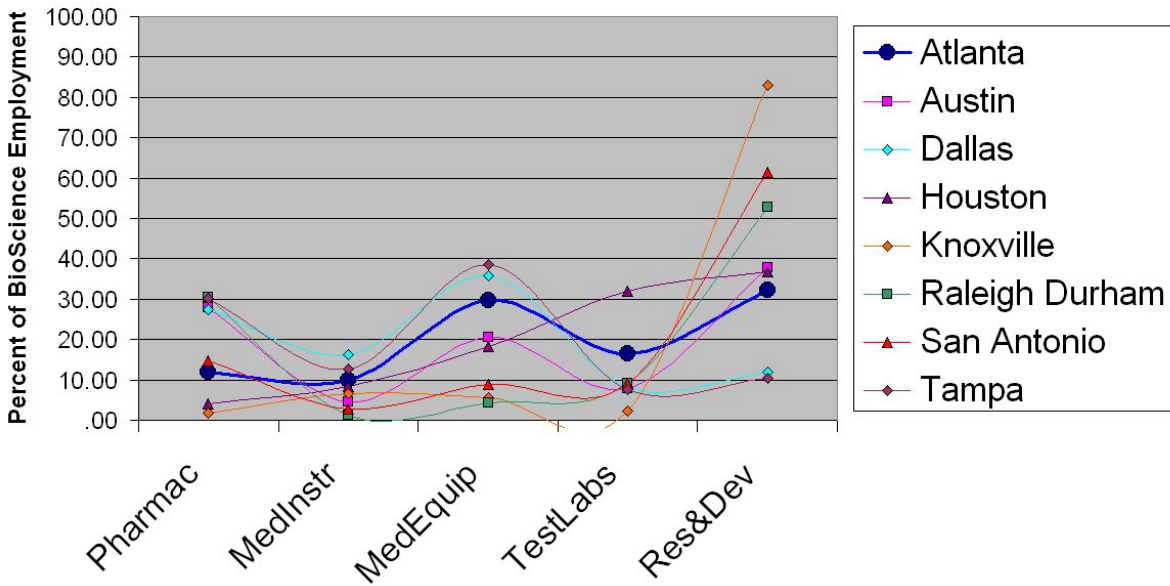
Figure 2.6 compares Atlanta and large national clusters, or MSAs with 25,000 or more bioscience employees. In a sense, these MSA could be considered examples of a fully developed cluster. Compared to these national clusters, Atlanta stands out as having much higher percentages of bioscience employees in medical and surgical equipment and test laboratories. About 30 percent of Atlanta's bioscience employment is in medical and surgical equipment and nearly 20 percent is in testing laboratories. In contrast, the large national clusters are concentrated in pharmaceuticals or R&D. Washington, D.C. and San Diego stand out in research and development, with at least 60 percent of their bioscience employees concentrated in this subindustry. Chicago, New York, and Philadelphia have significant levels of employees—35 percent or more—in pharmaceuticals.

These findings suggest several issues for further consideration.

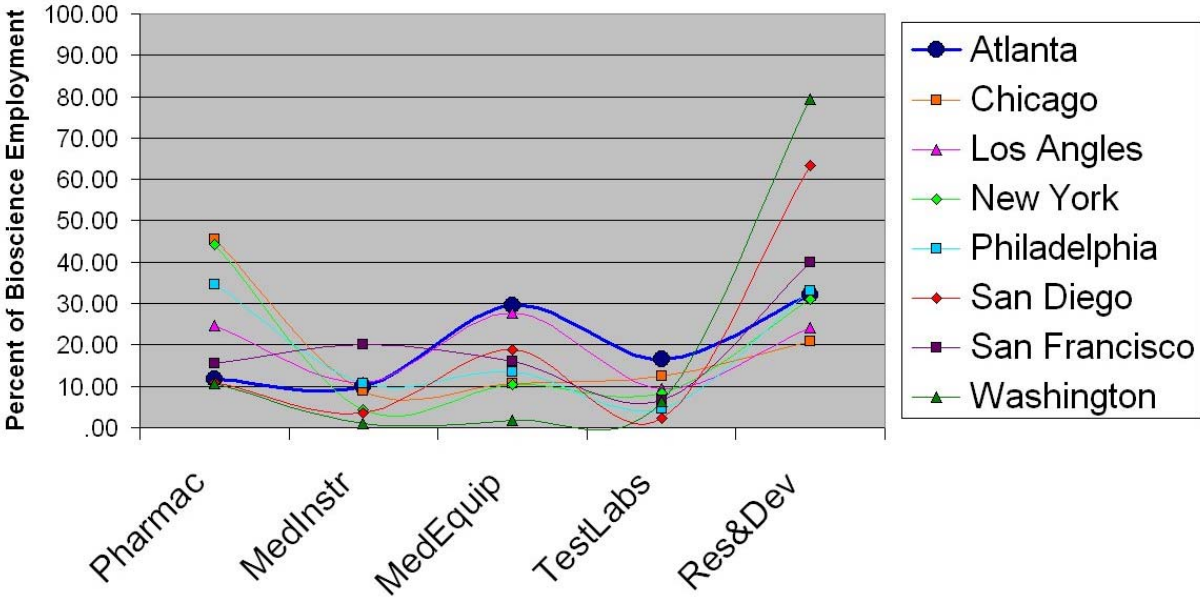
- whether pharmaceuticals and R&D institutions are more likely to help a region grow into a large cluster than equipment manufacturing and testing laboratories because pharmaceuticals and R&D firms may have stronger linkages to other bioscience companies that in turn help grow the cluster.
- whether older, larger, and more developed clusters grew based on strengths in pharmaceuticals and R&D, while newer, smaller clusters are growing based on equipment manufacturing and testing laboratories
- whether an expert panel could be assembled to determine if it makes sense for Atlanta to pursue these industries, and if so, which MSA approaches should be monitored and emulated.



**Figure 2.5. Bioscience Sector Profile: Atlanta Compared to Other Southern MSAs**



**Figure 2.6. Bioscience Sector Profile: Atlanta Compared to Large National Clusters**



## **Section 3**

# **Future Demand for Bioscience Employees**

Two types of workforce demand are considered in this section. The first is short-term demand, which reflects companies' immediate needs for employees in certain occupations or with certain qualifications based on the current business cycle and policy environment. It is measured in this study primarily by job openings from corporate job listings on Web pages.

The second is long-range demand, or projections of needs for workers. These projections are based on forecasts from the Georgia Department of Labor for 2000 to 2010. The aim of long-range demand projections is to show systemic changes in future employment. Long-range demand projections do not pick up spikes or drops in business cycles and certain changes in policy, business practice, or technology. They reflect persisting generational, demographic, and economic trends over time.

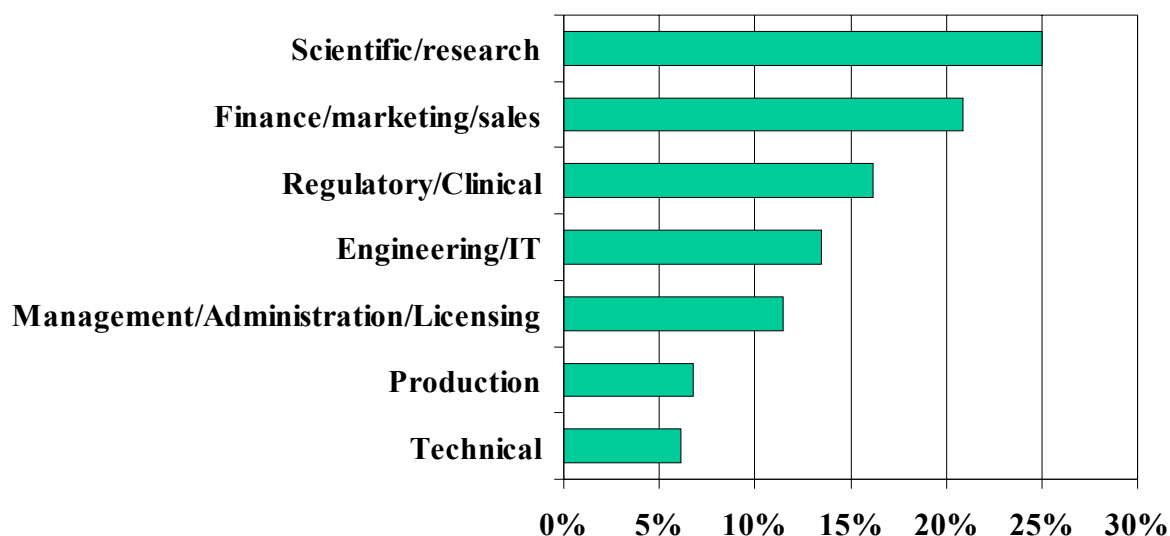
## **Short-Term Demand**

### **One-Fourth of All Advertisements Were for Research or Scientific Positions**

Of the 279 companies in the list, 48 companies have advertisements for people in life science related occupations (as of January and February of 2003). There are nearly 160 life science advertisements for positions in Georgia. The specific job titles and names of bioscience companies advertising them are listed in Appendix 1 and 2. About 20 percent of all identifiable bioscience companies in the state have advertised job openings during the current economic slow down. The median bioscience company looking to add employees has two open positions (mean number of open positions per hiring company is 3.6). The top companies based on advertised job openings were Merial, Elektra, Monsanto, Quintiles, Elan, Serologicals, and UCB Pharma.

By occupational category, scientific/research and finance/marketing/sales account for nearly half of job openings. (See Figure 3.1.) About 16 percent of jobs openings are clinical in nature. Nearly 14 percent are for engineering positions, and 12 percent involve management, licensing, or other administrative tasks. Only 7 percent are production jobs, and 6 percent are for technicians.

**Figure 3.1. Nearly Half the Life Science Job Openings in Georgia Involve Research/Scientific Positions or Finance/Marketing/Sales**



Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

### **Two Thirds of All Advertised Positions Require At Least A Bachelor's Degree**

Figure 3.2 shows the educational requirements of life science job openings in the state. Two-thirds of all job openings require at least a bachelor's degree. For many of these openings, educational stipulations depend on years of experience, with more education required depending on the applicant's years of experience. Twelve percent of job openings specify a Ph.D. or M.D. whereas 10 percent of job openings ask for applicants with two-year/associate's degrees.

### **More than 90 Percent of Bioscience Positions Require Experience**

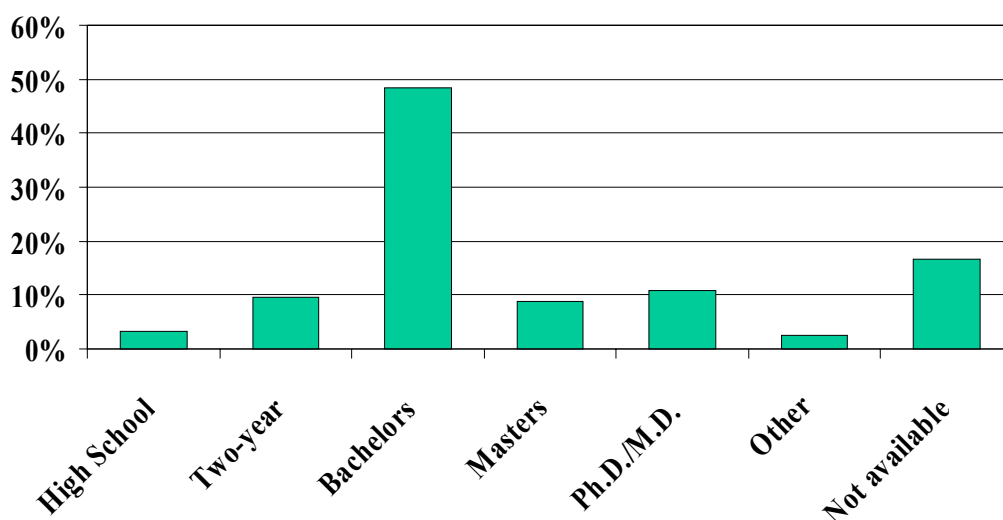
Bioscience positions in Georgia have a range of experience requirements. (See Figure 3.3.) Eight percent of job openings essentially are entry-level occupations, with one year or less of experience required. The other 90-plus percent require at least some industry-relevant experience. Just over half of the jobs require up to five years of experience, and the other half stipulate that five or more years of experience is needed. Senior-level jobs that call for more than 10 years of experience compose only about 5 percent of the posted job openings. In addition, there are a substantial number of job openings that require experience in some facet of life science but do not specify the number of years of experience. Regarding experience levels for different types of jobs, management and licensing positions tend to have the highest experience



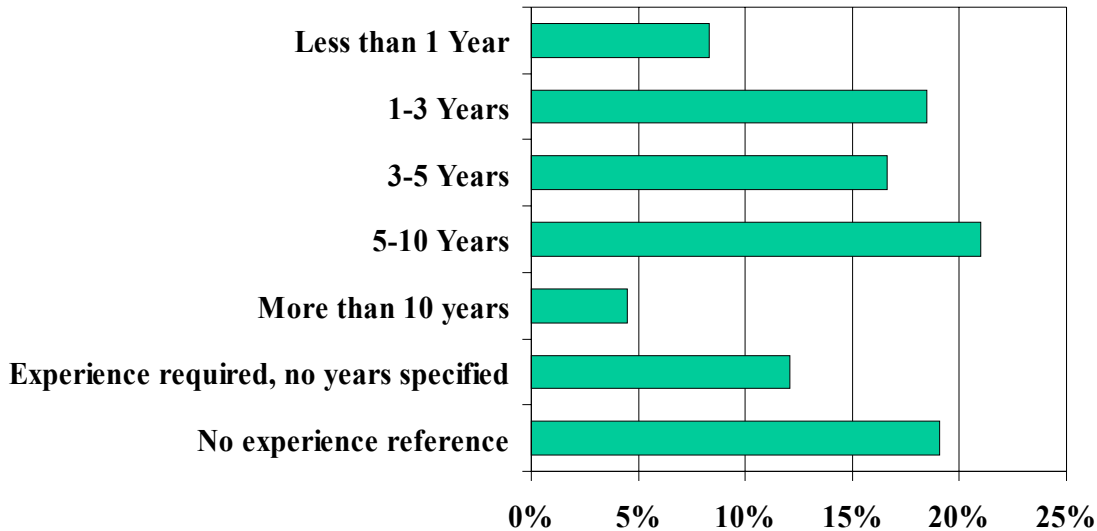
requirements. (See Table 3.1.) Sixty percent of these jobs require more than five years of experience. Scientific and research jobs also tend to have higher experience requirements

**Figure 3.2. Two-thirds of Bioscience Job Openings Require at Least a Bachelor's Degree**

\*Jobs in the bachelor's, master's, and Ph.D./M.D. educational categories sometimes have higher educational level requirements depending on an applicant's years of experience.



Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

**Figure 3.3. Only 10 Percent of Bioscience Job Openings Require Less Than a Year of Experience**

Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

**Table 3.1. Management/Administration/Licensing and Scientific/Research Positions Require More Experience Than Other Life Sciences Positions**

Coded Title	Less than 1 Year	1-3 Years	3-5 Years	5-10 Years	More than 10- years	Experience Required,	Not Available	Total
						Years Not Specified		
Scientific/research	10%	20%	10%	35%	0%	10%	15%	100%
Finance/marketing/sales	6%	15%	24%	15%	6%	15%	21%	100%
Regulatory/clinical	15%	25%	15%	15%	0%	20%	10%	100%
Engineering/IT	9%	0%	36%	0%	9%	0%	45%	100%
Management/administration/ licensing	0%	12%	20%	44%	16%	0%	8%	100%
Production	13%	23%	10%	15%	0%	13%	26%	100%
Technical	0%	38%	0%	13%	0%	38%	13%	100%
Grand Total	8%	18%	17%	21%	4%	12%	19%	100%

Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

## **Long-Range Projections**

### **State Bioscience Occupations Projected to Have the Most Jobs Are Similar to the Nation**

Georgia's top 15 bioscience-related occupations with the largest number of jobs projected from 2000-2010 closely resemble those of the nation. (See Table 3.3.) Radiologic technicians and medical and clinical laboratory technicians head the list, followed by surgical technologists. Georgia's next biggest bioscience occupation in terms of projected demand is chemical technicians, whereas U.S. projections point to veterinary assistants. Based on a distinction between core occupations (with the most direct importance to bioscience) and related occupations (those important to sectors other than bioscience), one should pay particular attention to the core occupations with the largest number of projected new jobs: medical and clinical laboratory technicians, chemical technicians, chemists, and medical equipment preparers.

### **Demand for Talent in Georgia's Core Bioscience Occupations Will Be Higher Than for the Nation**

The state's top 15 fastest-growing bioscience-related occupations differ markedly from those of the nation. Georgia's fastest-growing occupations include more core bioscience occupations than do those of the nation. Biochemists and biophysicists are at the top of the state's list, albeit growing from a small base. Georgia's next fastest-growing bioscience occupations are environmental engineering technicians, environmental engineers, medical scientists, and biomedical engineers. In contrast, the nation's fastest-growing occupations are in the veterinary services area.

By 2010, demand for core bioscience workers in Georgia will be 28 percent higher than in 2000. Nationally this growth rate is only 19 percent. However, the percentage growth rate for workers in related occupations in Georgia is very similar to that of the nation (27.5 percent for Georgia compared to 23.4 percent for the nation). One would expect Georgia's percentage growth rates to be higher than those of the nation to be higher because the state has a smaller base. Nevertheless, these percentages show that Georgia will experience demands for these occupations more rapidly than does the nation.

**Table 3.2. Fastest-Growing Bioscience Occupations Projected Through 2010:  
Largest Number of New Jobs and Fastest Growing in Georgia and United States**

Top 15 Georgia Bioscience Occupations (in descending order by greatest growth)			Top 15 US Bioscience Occupations (in descending order by greatest growth)		
Occupation	Type	Number of New Jobs 2000-2010	Occupation	Type	Number of New Jobs 2000-2010
Radiologic Technologists and Technicians	Related	1,760	Radiologic Technologists and Technicians	Related	193,036
Medical and Clinical Laboratory Technicians	Core	1,550	Medical and Clinical Laboratory Technicians	Core	138,847
Medical and Clinical Laboratory Technologists	Core	1,080	Medical and Clinical Laboratory Technologists	Core	125,462
Surgical Technologists	Related	940	Surgical Technologists	Related	123,341
Chemical Technicians	Core	840	Veterinary Assistants and Laboratory Animal Caretakers	Related	109,454
Environmental Engineers	Related	810	Engineering Managers	Related	100,197
Engineering Managers	Related	790	Veterinary Technologists and Technicians	Related	96,618
Environmental Scientists and Specialists	Related	550	Veterinarians	Related	91,918
Chemists	Core	510	Chemists	Core	86,462
Cardiovascular Technologists and Technicians	Related	480	Environmental Scientists and Specialists, Including Health	Related	67,243
Environmental Engineering Technicians	Related	430	Cardiovascular Technologists and Technicians	Related	67,170
Compliance Officers	Related	420	Environmental Engineers	Related	63,677
Chemical Equipment Operators and Tenders	Related	350	Biological Technicians	Core	56,947
Veterinary Assistants and Laboratory Animal Caretakers	Related	320	Compliance Officers	Related	56,944
Medical Equipment Preparers	Core	280	Chemical Technicians	Core	55,003

Top 15 Georgia Bioscience Occupations (in descending order by percentage growth)			Top 15 US Bioscience Occupations (in descending order by percentage growth)		
Occupation	Type	Percentage Change 2000-2010	Occupation	Type	Percentage Change 2000-2010
Biochemists and Biophysicists	Core	80.0%	Veterinary Assistants and Laboratory Animal Caretakers	Related	40.4%
Environmental Engineering Technicians	Related	71.7%	Veterinary Technologists and Technicians	Related	39.6%
Environmental Engineers	Related	57.9%	Veterinarians	Related	35.9%
Medical Scientists, Except Epidemiologists	Core	50.0%	Cardiovascular Technologists and Technicians	Related	35.1%
Biomedical Engineers	Core	50.0%	Surgical Technologists	Related	34.7%
Surgical Technologists	Related	47.7%	Biomedical Engineers	Core	32.0%
Chemical Technicians	Core	46.7%	Environmental Engineering Technicians	Related	30.3%
Cardiovascular Technologists and Technicians	Related	45.7%	Biological Technicians	Core	27.6%
Biological Science Teachers, Postsecondary	Core	41.2%	Environmental Science and Protection Technicians	Related	25.6%
Environmental Scientists and Specialists	Related	39.9%	Environmental Engineers	Related	25.5%
Radiologic Technologists and Technicians	Related	38.5%	Environmental Scientists and Specialists	Related	24.2%
Health Specialties Teachers, Postsecondary	Related	38.1%	Radiologic Technologists and Technicians	Related	23.2%
Chemistry Teachers, Postsecondary	Core	37.0%	Nuclear Medicine Technologists	Related	22.4%
Medical and Clinical Laboratory Technicians	Core	35.4%	Chemists	Core	19.6%
Nuclear Medicine Technologists	Related	34.0%	Medical and Clinical Laboratory Technicians	Core	19.3%

## Conclusions

Although Georgia may have traditionally been considered a sales outpost for high-tech firms—and the short-term demand analysis showed that a quantity of the current job openings in the state still are marketing/sales/finance positions—the state’s life science firms are adding many scientific and research posts. These findings signal a continued need for life science research capabilities. Long-term demand suggests that the rate of demand through 2010 for core bioscience research-related jobs in Georgia will only intensify.

Educational attainment is a fundamental attribute of life science jobs in Georgia. While most jobs require a bachelor’s degree, Georgia has a significant segment of jobs requiring a Ph.D. or M.D. at one end of the spectrum and a similarly sized segment of associate-degree-level jobs at the other end. Both of these types of occupations are expected to add many jobs through 2010.

But even more important is experience. Bioscience firms connect education to experience level, requiring more education with less time in the industry. Nine out of 10 bioscience openings have some experience requirement, and more than one-third of these life science research positions stipulate up to 10 years or more of substantial industry experience.

Because of this underlying experience factor, two ongoing human resource concerns in Georgia have been the lack of entry-level positions and the lack of experienced bioscience specialists (ARCHE, 2002). This analysis suggests that Georgia indeed has a modest number of entry-level positions. Only 13 of the 157 job openings in our database could be filled by persons with little or no industry experience. Very few bioscience firms appeared to have formal cooperative educational programs or apprenticeships that could provide enough experience to allow new-to-the-industry applicants to qualify for job openings in the state.

At the other end of the experience continuum, an even smaller number of positions (seven) were for highly experienced bioscience specialists with more than 10 years in the industry. These were most likely to be management and licensing or scientific and research positions. These types of senior positions tend not to be advertised, so the data reported about them may understate the size of demand.

Georgia has attained success in attracting and developing firms with research-based human resource needs. It does seem that the state's early strength in sales and marketing jobs is now being complemented by scientific and research elements much as in the national bioscience market. Educational requirements are high for these types of scientific and research jobs. But attention should also be paid to providing industry experience to qualify for these types of life science jobs.

## **Section 4**

# **Shortfall Analysis**

The objective of shortfall analysis is to estimate what unmet demand companies will have for employees in certain occupations. This estimate is over and above any postsecondary institution graduates available for hire and any employees moving into the state (less the number leaving the state).

## Shortfall Analysis: Four Components

### Annual Openings

Shortfall analysis consists of four main components. (See Table 4.1.) The first is annual openings. These are calculated on a yearly basis from the long-range projections of demand for employees by occupation from 2000 through 2010. Annual openings also include net replacements, which comprise workers who transfer from other occupations or who leave the workforce. Annual openings reflect economic growth and replacements, but do not cover persons leaving the state and persons changing occupations. Annual openings enable comparisons to be made with other annual data over the forecast time period.

#### **Table 4.1. Bioscience Shortfall Analysis**

**Annual job openings** in bioscience occupations projected from 2000-2010

**MINUS Supply of graduates in bioscience majors** for 1999-2000 in all public and private postsecondary institutions in Georgia

**MINUS Supply of net migrants** or employees in bioscience occupations coming into Georgia from other states (and out from Georgia to other states) from the 2000 census

**EQUALS Occupations with annual bioscience shortfalls** through 2010

### Occupational Supply

A second component is supply.

Occupational supply is the number of graduates by major from all the postsecondary educational institutions in Georgia. The significance of the supply component in the shortfall analysis is reflected in this question. If postsecondary institutions continue to graduate the same number of students with the same majors, what impact will that have on filling the demand for workers in bioscience occupations?

To estimate supply, researchers gathered data on number of graduates by major in Georgia's postsecondary institutions. These institutions include USG colleges and universities, private colleges and universities, DTAE colleges, and nonprofit and proprietary technical



institutions. The Integrated Postsecondary Education Data System (IPEDS) serves as the primary data source for occupational supply analysis. Administered by the National Center for Educational Statistics (NCES) of the U.S. Department of Education, IPEDS includes national, state, and institution-level information (such as enrollment program completion, faculty, staff, finances, and academic libraries) from some 12,000 postsecondary institutions. The most recent data available on completions (graduates) from these institutions is as of 2000. The occupational supply analysis focuses on the data relating to the classification of instructional programs (CIP). The CIP represents all primary fields of study leading to degrees or certificates. There are nearly 900 such classifications, most unrelated to bioscience occupations.

To select the bioscience CIPs, Georgia Tech researchers compiled lists provided by USG and DTAE and matched them to the most recent listing of CIP codes. There are about 50 bioscience CIPs. (See Table 4.2.) In general, researchers erred on the side of inclusiveness. For example, agricultural business majors are probably more apt to work in farming or food processing than in bioscience. Similarly, veterinary medicine graduates or radiologic techs are more apt to work in pet or human health care services than in bioscience. The exception was the treatment of computer science and manufacturing instructional programs, which, because they serve other sectors more than bioscience, more properly belong with separate manufacturing or information technology sectors.

Biology was the bioscience CIP with the largest number of graduates—more than 760 over the one-year period under analysis. Chemistry was next with nearly 300, followed by chemical engineering with more than 160. Animal sciences, microbiology/bacteriology, and veterinary medicine each exceeded 80 graduates. Of the associate degree-related majors, surgical technician was the largest, graduating more than 50 students.

**Table 4.2. Bioscience Classification of Instructional Programs**

01.0102 Agricultural Business/Agribusiness Operations	26.0613 Genetics, Plant and Animal
01.0103 Agricultural Economics	26.0699 Miscellaneous Biological Specializations, Other
01.0302 Agricultural Animal Husbandry and Production Management	26.0701 Zoology, General
01.0304 Crop Production Operations and Management	26.0702 Entomology
02.0201 Animal Sciences, General	26.0705 Pharmacology, Human and Animal
02.0206 Dairy Science	26.0706 Physiology, Human and Animal
02.0209 Poultry Science	26.1201 Biotechnology
02.0301 Food Sciences and Technology	27.0301 Applied Mathematics, General
02.0403 Horticulture Science	30.0101 Biological and Physical Sciences
02.0408 Plant Protection (Pest Management )	40.0501 Chemistry, General
03.0102 Environmental Science/Studies	40.0599 Chemistry, Other
03.0301 Fishing and Fisheries Sciences and Management	41.0301 Chemical Operations Technology
14.0301 Agricultural Engineering	51.0717 Medical Services Technician
14.0501 Bioengineering and Biomedical Engineering	51.0808 Veterinary Technology
14.0701 Chemical Engineering	51.0901 Cardiovascular Technology
15.0401 Biomedical Engineering Tech	51.0905 Nuclear Medicine Tech
26.0101 Biology, General	51.0909 Surgical Tech
26.0202 Biochemistry	51.0909 Surgical Technology
26.0301 Botany, General	51.0911 Radiologic Tech
26.0305 Plant Pathology	51.1004 Clinical Lab Assistant
26.0401 Cell Biology	51.1004 Medical Lab Technology
26.0501 Microbiology / Bacteriology	51.1004 Medical Laboratory Tech
26.0601 Anatomy	51.1009 Phlebotomy Technician
26.0607 Marine / Aquatic Biology	51.1309 Medical Molecular Biology
26.0612 Toxicology	51.2401 Veterinary Medicine (D.V.M.)
	51.2501 Veterinary Clinical Sciences (M S , Ph D )

### **Net Migration**

As part of the shortfall forecasts, Georgia Tech researchers estimate the effects of net migration of talent into the state. Net migration, or the number of people moving into the state minus the number leaving the state, is an important factor in Georgia. During the April 1, 2000 to July 1, 2001 time period, Georgia ranked third in domestic net migration and eighth in international net migration. The state has gained more workers than it has lost in nearly all occupational categories, and in many cases, the number of net migrants is a larger source of workers than are the graduates of all Georgia's higher educational institutions combined.

The top three bioscience occupations based on net migration are engineering managers, compliance officers, and chemical plant and system operators. Nearly 90 employees in these occupations are estimated to move into Georgia each year.

### **Crosswalk and Shortfalls**

To link the major occupational and instructional classification information, a crosswalk translation database from the National Crosswalk Service Center (NCSC) was used. NCSC employs survey-based relationships to determine the links between graduates and their majors and occupations.

Georgia Tech researchers used the crosswalk to allocate graduates, net migrants, and occupational employees. Researchers applied the crosswalk across the entire spectrum of occupations, not just the bioscience subset. Thus, not all the graduates in the bioscience CIPs map into the bioscience occupations. For example, of the 160 chemical engineering majors, about half can be expected to take jobs in a bioscience occupation.

With graduates, net migrants, and occupational employees linked, a simple subtraction furnishes projected shortfalls.

### **There Are Few Large Bioscience Shortfalls Distinguishable from the Health Care Sector**

Overall, the analysis does not find significant shortfalls. (See Table 4.3.) Among occupations requiring higher education degrees, none of the bioscience occupations is in the top 10 occupations with the largest annual shortfalls.

The largest bioscience shortfalls appear at the technician-level. Medical and clinical technicians have long-term annual shortfalls of about 180 jobs. This finding must be tempered by the fact that an overlap exists between biosciences and health care services at the technician-level. The ongoing needs of the considerably larger health care services sector make these technician-level deficits seem larger than bioscience firms really may be experiencing.

Another factor in interpreting the technician-level shortfall is that Georgia appears to have produced few graduates for these types of jobs in 1999-2000. At least in Georgia, these technician-level jobs do not appear to require an associate's degree as they do nationally. Because Georgia traditionally has not had large degree programs in these technician-level areas,

it is likely that workers enter these jobs through on-the-job training or related experience rather than through degree programs. The shortfall analysis cannot capture this substitution effect.

## **Conclusion**

Under current assumptions, the bioscience industry does not show significantly high long-term shortfalls. Due to the difficulties in analyzing publicly available data and the apparent overlap between bioscience and health care occupations, the state should continue to monitor the needs of companies in this industry. An ongoing deficit of technicians is apparent and warrants continuous monitoring. There may be sufficient supply today, but over the years if Georgia persists in turning out small numbers of graduates relative to the larger numbers of openings, there could be a future development bottleneck, especially if economic development efforts are successful.

**Table 4.3. Shortfall Analysis of Georgia Bioscience Occupations  
with at least 40 Annual Openings 2000-2010**

SOC	Description	Type	Openings	Graduates	Migration	Shortfall	Education Level
29-2034	Radiologic Technologists and Technicians*	Related	280	163	42	74	Associate's degree
29-2012	Medical and Clinical Laboratory Technicians*	Core	260	41	40	179	Associate's degree
11-9041	Engineering Managers	Related	210	551	421	(762)	Work experience plus bachelor's degree
29-2011	Medical and Clinical Laboratory Technologists	Core	200	121	35	44	Bachelor's degree
29-2055	Surgical Technologists	Related	150	136	19	(5)	Post-secondary vocational training
19-4031	Chemical Technicians*	Core	130	-	92	38	Associate's degree
13-1041	Compliance Officers	Related	120	-	67	53	Work experience
17-2081	Environmental Engineers	Related	110	6	52	52	Bachelor's degree
31-9096	Veterinary Assistants and Laboratory Animal Caretakers	Related	100	13	22	65	Short-term on-the-job training
19-2041	Environmental Scientists and Specialists, Including Health	Related	100	-	56	44	Bachelor's degree
19-2031	Chemists	Core	100	136	63	(99)	Bachelor's degree
51-8091	Chemical Plant and System Operators	Related	90	-	87	3	Long-term on-the-job training
51-9011	Chemical Equipment Operators and Tenders	Related	80	-	33	47	Moderate-term on-the-job training
29-2031	Cardiovascular Technologists and Technicians	Related	70	13	10	47	Moderate-term on-the-job training
17-3025	Environmental Engineering	Related	60	2	4	54	Associate's degree
31-9093	Medical Equipment Preparers	Core	60	72	10	(21)	Short-term on-the-job training
29-1131	Veterinarians	Related	50	34	22	(6)	First professional degree
11-9121	Natural Sciences Managers	Related	50	669	24	(643)	Work experience plus bachelor's degree
19-1022	Microbiologists	Core	40	-	31	9	Doctoral degree
17-2041	Chemical Engineers	Core	40	12	25	3	Bachelor's degree
25-1042	Biological Science Teachers, Postsecondary	Core	40	310	13	(283)	Doctoral degree
25-1071	Health Specialties Teachers, Postsecondary	Related	40	970	15	(946)	Doctoral degree

\* Across the country, people with Associate's degrees usually fill these positions. However, in Georgia, institutions do not offer significant numbers of the corresponding higher education programs. So, we expect that these positions in Georgia are filled through on-the-job training or moving from related occupations rather than degree graduates as they are in the rest of the country. What appear to be shortfalls are probably already accommodated.

## **Section 5**

# **Wage Analysis**

## **Wage Analysis Issues and Methods**

Georgia's vision of its bioscience talent is that wages are not an obstacle to attracting and retaining talent. This section assesses the extent to which Georgia pays wages that are competitive to national salary benchmarks.

The issue of wage rates is a double-edged sword. On the one hand, it is important to pay wages that are high enough to attract and retain the best talent in bioscience industries. On the other hand, companies will seek to optimize their labor costs to remain market competitive.

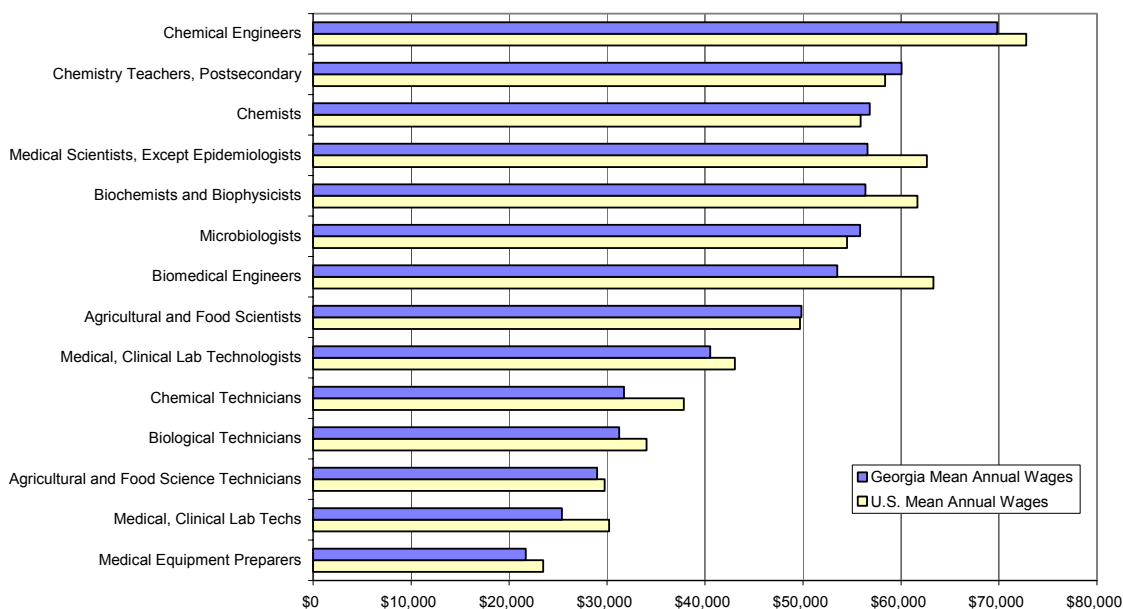
This wage analysis uses national and Georgia 2001 estimates from the Occupational Employment Statistics survey. Each state's employment security agency (here, the Georgia Department of Labor) conducts the survey over a three-year period, using the fourth quarter as a reference year. The survey asks about occupational employment and wages for wage and salary workers by industry sector. Employment and wage results are presented for each SOC category. This analysis has assessed the subset of core bioscience SOCs.

## **Core Bioscience Salaries in Georgia Are Slightly Below National Benchmarks**

Nationally, the mean employee in a core bioscience occupation in 2001 was paid nearly \$46,000. The average for Georgia was approximately \$38,000. This difference is not statistically significant based on the standard errors presented in the two surveys.

Average U.S. salaries were higher than Georgia's in all but three core bioscience occupations. Two of the three occupations for which Georgia's mean annual salaries were higher than the U.S. average are notable because they are important research positions: microbiologists and chemists. Georgia employees were paid about \$1,000 more on average in these positions than the U.S. mean. On the other hand, U.S. mean salaries were more than \$5,700 higher than Georgia's for the following occupations: biomedical engineers, biochemists, and biophysicians, medical scientists, and chemical technicians. (See Figure 5.1. and Appendix IV for data listing.)

**Figure 5.1. U.S. Mean Annual Wages Are Above Georgia's for all But Three Bioscience Occupations**



## Conclusions

Georgia's wages currently are roughly comparable with national averages. However, wage differentials do exist at technician-level positions.



## **Section 6**

# **Executive Interviews**

## **Introduction and Method**

This section illustrates the extent to which interviews with human resource and senior executives at bioscience firms in the state support the quantitative data findings. It also highlights suggestions and advice to enhance the supply and demand of bioscience employees in Georgia.

Ten bioscience firms were selected to participate in the executive interviews. The firms differed considerably in size, subindustry, and year of establishment. Four of the firms had more than 200 employees; another four firms had fewer than 20 employees. Three firms were in pharmaceuticals, two in medical devices and health care, and the remainder in biotechnology. Although most of the firms were started in the 1990s, two were just established in the last three years, whereas another two were 20 or more years old. Two of the firms were outside metro Atlanta and the rest were located in the Atlanta MSA.

Researchers conducted intensive one-on-one interviews with senior executives or human resource managers in larger firms. Each interview lasted from one to two hours. Interviews followed the protocol in Appendix 4, which addressed hiring experiences and needs, availability and cost of talent, and sources of talent including postsecondary institutions. Each interviewee also was asked to suggest policy or programmatic enhancements.

Responses from the interviews were for the most part remarkably consistent. Major findings are summarized below.

## **Experience Is of More Interest Than Education, Particularly to Start-up Companies**

Respondents reported that most of their core positions required a minimum of a bachelor's degree. Biology and chemistry degrees were most common. However, education alone was not sufficient. Few firms were hiring at the entry level. One company reported hiring an entry-level research associate. Another routinely hired technician-level employees without prior experience. Larger companies were more willing to hire graduates right out of school and train them. The smaller the company, the more interested it was in employees with experience. Smaller companies did not have time to translate the degree into the job skill. Respondents'

major critique of university graduates was that they had no practical experience. At least one respondent valued graduates that had worked as laboratory assistants while in college. But most said they had difficulty working with entry-level college graduates because they did not know how to perform fundamental work tasks such as running a laboratory or conducting a beta test.

Most firms sought candidates with experience that directly related to the advertised position. Examples include laboratory experience for research associates, clinical experience for a director of clinical operations, quality assurance or quality control experience for a quality assurance specialist. More years of experience were expected not only for higher-level (e.g., management) positions, but also for positions requiring master's or higher degrees. Entry-level positions for persons with advanced degrees were nonexistent.

## **Shortages Were Reported Across Diverse Clinical and Scientific Bioscience Occupations**

There was much diversity in the types of clinical and scientific occupations that bioscience executives had difficulty recruiting. A range of occupations was mentioned: biostatisticians, bioinformatics specialists, regulatory affairs directors (with comprehensive knowledge of U.S. Federal Drug Administration rules and regulations), research laboratory directors, and quality assurance specialists. Most needed was experienced talent with special expertise in these and other similar occupations.

Respondents had no trouble filling technician and general administrative positions. Animal and laboratory technicians were widely available from hospitals, the Red Cross, Yerkes National Primate Research Center, veterinarians, and other health care providers. Little if any experience was required for technician positions. Non-scientific and administrative jobs—accountants, administrative assistants, computer programmers and other information technology personnel, and sales managers—were also easy for these companies to fill.

## **Recruitment Is Hampered by a Lack Bioscience Company Critical Mass**

The bioscience executives interviewed for this study advertise for positions primarily

through the Web. They post jobs to their corporate Web site, and some post to bioscience specialty Web sites. To supplement the Web, firms take out advertisements in *The Atlanta Journal-Constitution*. They also use recruiters, placing particular value on recruiters with specialized bioscience knowledge.

Many of the bioscience firms reported they do not think of colleges and universities as a source of talent. They do not actively recruit at universities.

The biggest and most significant pool of new employee resources is from other bioscience companies. These companies also have the research scientists, clinical directors, and quality assurance specialist that other bioscience firms need and desire. The problem is that there are not enough firms in similar bioscience subsectors. Respondents said that Georgia's bioscience industry is spread thinly across a broad range of unrelated bioscience firms. These firms cannot be lumped together because they are unique in what they do.

Experienced talent is reluctant to come to Georgia because of this lack of critical mass in a given bioscience subsector. If their job does not work out, they can have difficulty finding another similar position. In contrast, places like New Jersey have enough similar bioscience companies to make it easy for employees to change jobs. Respondents could not name more than one or two other Georgia firms that fell into their bioscience subsector.

## **Georgia Bioscience Salaries Are Perceived to Be Competitive**

Most respondents recruit experienced scientific and clinical talent from a national pool. They compete for talent with firms in peer industries in the Northeast, the West Coast, North Carolina, and to some extent Texas. Even though Georgia's cost of living may be less than some of these locations, prospective employees would perceive a lower salary offering as a pay cut. So, Georgia firms must offer salaries that are at least at the national industry average, not state average, to compete for talent with these regions. This is not just an issue of attracting talent; it is also important in retaining existing employees. Some of firms participating in this study have recently increased their wage levels to national industry averages so that they could keep their employees. Several respondents mentioned using national surveys of pharmaceuticals and other similar industries to set pay scales for scientific and clinical occupations. The same is not true of

technician or non-scientific administrative occupations, which are compensated according to state benchmarks. But for scientific and clinical talent, the compensation benchmark is the national industry, not the local geographic market.

### **More Should be Done to Publicize Georgia's Biotech Strengths**

Respondents told researchers that Georgia needs to do a better job of letting people within and outside the state know that a significant biotech industry exists here. Outside the state, Georgia is not perceived as a major biotech center, which adversely impacts their recruitment efforts. Georgia is rarely listed on bioscience Web sites, for example. Not enough information about the number and size of bioscience firms in Georgia is released to venues frequented by prospective employees. There is also a lack of knowledge on the part of the state's bioscience firms. A few of the respondents did not realize how many bioscience firms the state has. More than one reported that the first experience they had with knowing of other bioscience firms in the state was The Life Sciences HR Xchange being created for bioscience human resource managers. They recommended that local and state governments and chambers continue to promote bioscience networks and strengths to audiences inside and outside Georgia.

## **Section 7**

# **Summary and Recommendations**

Bioscience is an important strategic industry to the state. Now that Georgia has developed a significant base of bioscience firms, the state should examine ongoing human resource issues to further support the sector. This study has provided a template through its examination of bioscience employment issues from a national perspective, forecast of future demand relative to existing supply and migration trends, and comparative assessment of Georgia and national wages. Based on this information, researchers summarize key findings and suggest the following recommendations for enhancing demand and supply of bioscience workers.

### **Educational Offerings Should Incorporate Experience**

Lack of experience is the most significant gap in postsecondary institution programming. Nine out of 10 bioscience openings require industry-relevant experience. This is particularly true of research and management positions. And although executives interviewed for this study mentioned having needs to fill positions in a diverse range of occupations (e.g., biostatistician, regulatory affairs, quality assurance), the common thread was the need for professionals with specialized experience in these positions.

It is recommended that Georgia's educational institutions increase offerings containing relevant corporate and governmental experience. More internships, externships, and co-ops should be offered such that when students graduate they have at least one year of bioscience-sector experience. Academic programs also should increase corporate-sponsored research assistantships where local researchers work cooperatively with company researchers or managers on joint projects. Consideration should also be given to certificate programs for executives. All of these programs are predicated on a closer partnership between industry and postsecondary education. In addition to educational programs, attention should be paid to recruiting more experienced bioscience professionals.

### **Georgia's Pay Should Continue to be Tracked Against National Benchmarks**

Although executives are concerned about attracting and retaining senior managers and specialists, wages are not considered a major issue. Pay offerings in Georgia are roughly

comparable to national benchmarks, albeit on the low end at more than \$5,700 below the national average. Compensation may not be a significant current impediment to bioscience employment growth, but may become an issue. Admittedly, it can benefit a firm or state to restrict pay levels to preserve a low cost business environment. However, intense national (if not international) competition for bioscience talent makes it important to offer sufficient compensation to attract and retain senior managers. The need for competitive salaries is particularly important to cities such as Atlanta, which want to build a bioscience cluster from a relatively smaller and less well-known base. It is recommended that state and local economic developers continue monitoring salaries relative to national benchmarks to make it evident that Georgia's wages are nationally competitive.

### **Concerns about Technician-Level Shortfalls Should Be Directed at Health Care Industries**

State and national occupational employment forecasts call for long-term shortfalls in medical and clinical laboratory technician and technologist positions. However, current demand measures do not show a great shortage of these occupations, and executive interviews even suggest that there are plenty of technicians for the number of available bioscience positions today. Not all medical and clinical laboratory technicians will work in a bioscience company; most will work in health care services settings. Still, Georgia institutions do not offer programs that produce significant numbers of graduates for these positions. As a result, many of these technician-level positions in Georgia are probably being filled by workers receiving on-the-job training or moving from related occupations. Educators should track the relationship between demand for medical and clinical laboratory technicians and the supply of graduates through 2010 to assess when shortfalls dictate the need for increasing technician training resource allocation.



## **Local and State Developers Should Focus Image-building and Targeting Strategies**

Executives believe that the perceived lack of a critical mass of similar companies in Georgia limits their ability to attract and retain the medical and clinical specialists they need. To some extent, this is an image and publicity concern and to some extent it is grounded in hard numbers. Employment data shows that although Georgia has a sizable number of bioscience employees, they are not concentrated in any particular subsector. This lack of concentration is particularly apparent in comparisons with other southern and national clusters. The state should review its image-building and targeting strategies based on this information. Targeting and developing more pharmaceutical and R&D firms could have major implications for the type of talent needed in Georgia's future bioscience industries.

## **Human Resource Information Should Continue to Be Tracked**

This study has demonstrated that there is value in having a systematic method for tracking employment trends in bioscience industries. It is recommended that tracking of bioscience-related employment demand, supply, and wage information be continued.

To be sure, there are challenges in defining the dynamic bioscience industry using government classifications developed for traditional sectors. Nevertheless, the study has shown that, with caveats, it is possible to delineate a subset of existing government, industry, occupational, and instructional classifications that compose the bioscience sector.

Perhaps the biggest caveat is that bioscience exists against the larger backdrop of health care, manufacturing, information technology, and other similar sectors. It is therefore important to set down a smaller group of occupations and instructional programs that are more closely identified with biosciences. We call these occupations and programs “core,” to be distinguished from the broader set of classifications, which we called “related.” These distinctions should be observed in any ongoing monitoring program.

## **Section 8**

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**Appendix I**

# **Methodology for Short and Long-term Demand Analysis**

## Short-Term Demand Methods

One of the biggest challenges of measuring short-term demand in Georgia's bioscience industries is finding a comprehensive list of bioscience firms. MACOC provided a database of 247 life science companies in metropolitan Atlanta and the rest of Georgia. In addition, Georgia Tech researchers used a list published in the *Atlanta Business Chronicle*<sup>1</sup> which added another 32 non-duplicate firms, for a total of 279 life science companies in Georgia. While this list may not pick up very new, relatively unknown bioscience firms, it does include a range of large and small companies likely to have hiring needs.

All of the executives and human resource managers interviewed by Georgia Tech researchers reported that they posted open positions on their Web sites and relied on these Web postings, supplemented by other sources, to recruit employees. (See Section 6.) Therefore, the primary source for this analysis was the Web sites of Georgia bioscience firms. Researchers located the Web site of each company in the 279-firm list. If the Web site was found, a more specific search for job openings in Georgia was conducted. If the company did not have a Web site, or if the Web site raised questions, researchers called the company to determine if it had job openings in Georgia.<sup>2</sup> Researchers then developed a database containing all advertised job openings. Each position was coded in a job-type classification based on the standard categories in the Biotechnology Use and Development Survey 1999 conducted by Statistics Canada. In addition, educational and experience requirements were ascertained.

Using Web postings, augmented by interviews, does have some limitations in making generalizations about short-term demand. Findings and conclusions from this data reflect only publicly advertised positions. Some jobs are obtained through word of mouth and are never made public. Furthermore, in these economic times, a bioscience company may have a need to hire more people, but cannot afford to or otherwise does not choose to do so. Nevertheless, these data do provide a sense of the state's life science human resource needs as they relate to the type of job and educational and experience requirements.

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<sup>1</sup>Don Reichardt, "2003 outlook for Georgia's biotech industry," *Atlanta Business Chronicle*, January 17, 2003.

<sup>2</sup>Many of the companies called were small and did not have job openings.

## Long-Term Demand Methods

Long-run demand projections from state and federal governments are based on sophisticated econometric models. These models take into account the size and demographic composition of the labor force, the growth of the aggregate economy, final demand or gross domestic product (GDP), and interindustry relationships (input-output). Model developers look outward over 10 years based on the knowledge they have as of the base year (2000). Surveys of employers conducted every three years by the Georgia Department of Labor furnish information for the in-state estimation process.

The national occupational demand model estimates employment for 262 industries, then applies an industry-occupational staffing pattern matrix to produce projections for nearly 650 standard occupational classifications (SOC) nationally. The Georgia model produces projections for more than 750 SOCs. Despite such a large number of occupations, it is still difficult to home in on occupations that are only applicable to bioscience firms. For example, sales managers and information technology professionals, while important to bioscience firms, serve many other occupations as well and more properly belong to the sales or information technology sectors. Georgia Tech researchers used the industry-occupation matrix to identify which occupations most closely relate to the bioscience NAICS codes in Section 2. Any occupations substantially linked more to other industries than to bioscience were eliminated.

The table below presents the resulting list of bioscience occupations. The list includes core occupations, those with the most direct importance to bioscience, and related occupations, those important to sectors other the bioscience. For example, radiologic technicians are categorized as a related occupation because they are more directly linked with health care services than with bioscience sectors.

## SOC-based Bioscience Occupations Used in This Study

Type	SOC Code	Description	Type	SOC Code	Description
Related	11-9041	Engineering Managers	Related	19-4092	Forensic Science Technicians
Related	11-9121	Natural Sciences Managers	Core	25-1042	Biological Science Teachers, Postsecondary
Related	13-1041	Compliance Officers	Core	25-1052	Chemistry Teachers, Postsecondary
Related	15-2021	Mathematicians	Related	25-1071	Health Specialties Teachers, Postsecondary
Related	15-2041	Statisticians	Related	29-1131	Veterinarians
Related	15-2091	Mathematical Technicians	Core	29-2011	Medical and Clinical Laboratory Technologists
Related	17-2021	Agricultural Engineers	Core	29-2012	Medical and Clinical Laboratory Technicians
Core	17-2031	Biomedical Engineers	Related	29-2031	Cardiovascular Technologists and Technicians
Core	17-2041	Chemical Engineers	Related	29-2033	Nuclear Medicine Technologists
Related	17-2081	Environmental Engineers	Related	29-2034	Radiologic Technologists and Technicians
Related	17-3025	Environmental Engineering Technicians	Related	29-2055	Surgical Technologists
Core	19-1010	Agricultural and Food Scientists	Related	29-2056	Veterinary Technologists and Technicians
Core	19-1021	Biochemists and Biophysicists	Related	29-9010	Occupational Health and Safety Specialists and Technicians
Core	19-1022	Microbiologists	Core	31-9093	Medical Equipment Preparers
Related	19-1023	Zoologists and Wildlife Biologists	Related	31-9096	Veterinary Assistants and Laboratory Animal Caretakers
Related	19-1041	Epidemiologists	Related	45-2011	Agricultural Inspectors
Core	19-1042	Medical Scientists, Except Epidemiologists	Related	49-9062	Medical Equipment Repairers
Core	19-1099	Life Scientists, All Other	Related	51-8091	Chemical Plant and System Operators
Core	19-2031	Chemists	Related	51-9011	Chemical Equipment Operators and Tenders
Related	19-2041	Environmental Scientists and Specialists			
Core	19-4011	Agricultural and Food Science Technicians			
Core	19-4021	Biological Technicians			
Core	19-4031	Chemical Technicians			
Related	19-4091	Environmental Science, Protection Technicians			

## **Appendix II**

# **Short-Term Demand: Detailed Occupational Titles**



Account Executive  
Account Executive  
Accounts Payable Specialists (ATL)  
Accounts Receivable Accountant  
Administration Associate (IV) (ATL)  
Administrative Assistant II (ATL)  
Advanced Chemical Process  
Development Engineer  
Analyst III  
Associate Director, Regulatory Affairs  
(ATL)  
Associate Director, Regulatory Support  
& Liaison (ATL)  
Associate Medical Director, CNS (ATL)  
Associate Microbiologist  
Associate Microbiologist  
Associate Set Up Manager (ATL)  
Automation Engineer  
Biology Research Specialist (ATL)  
Business Development Executive  
Business Services Manager  
Buyer/Planner 9 (ATL)  
Calibration Supervisor  
Chemist (ATL)  
Chemistry Group Leader  
Clinical Applications Specialist  
Clinical Project Manager  
Collections Specialist  
Commodity Manager/ Packaging and  
Non-Inventory  
Computer Validation Specialist  
Customer Care Representative/ 11  
(ATL)  
Customer Service Engineers or  
Biomedical Engineers  
Customer Service Representative/  
PAGE, 11 (ATL)  
Cytotechnologist 1  
Director of Health Physics / Radiation  
Safety Officer  
Director, Clinical Operations  
Director, Clinical Research  
Director, Lab Services  
Director, Project Management  
Electrical Engineer  
Electrical Engineer

Electrical Engineer  
Electrical Engineering Co-op  
Environmental Monitoring Technical  
Lead  
Executive-Strategic Accounts  
Field Support Engineer  
Financial Analyst Corporate (ATL)  
Freeze Drying and Refrigeration  
Specialist  
GCP Compliance Manager  
Global Bio Marketing & Product  
Development Director (ATL)  
Global Pharmaceutical Technical  
Marketing & Product Development  
Director (ATL)  
Group Tax Director (ATL)  
Hourly Lab Work  
Human Research Generalist  
Installation Engineer  
Investigator Service Rep 1 (ATL)  
IT Manager  
Key Account Manager, Mid-Atlantic  
Key Account Manager, Northwest  
Key Account Manager, Southwest  
Kit Assembly (ATL)  
Kit Assembly 1st Shift (ATL)  
Laboratory Analyst  
Laboratory Chemists  
Manager Lab (ATL)  
Manager, IND Submission  
Manager, Manufacturing Technology  
(ATL)  
Manager, Regulatory Affairs (ATL)  
Manufacturing Cost Analysis, Animal  
Ag  
Manufacturing Technicians  
Marketing Project Coordinator  
Mechanical Engineering Co-op  
Medical Physicist  
Medical Physicist for R & D- Radiation  
Oncology  
Medical Technologist, Hematology  
(ATL)  
Methods Development Chemist  
Metrology, Biomedical Engineer (ATL)  
Microbiologist

Modality Manager  
 Nurse Practitioner  
 Office Manager  
 Office Manager  
 Operations Management Technician  
 Operations Manager  
 Pathologist-Corporate Sr.  
 Payroll Specialist  
 Planning System Analyst  
 Poultry Caretakers  
 Principal Scientist - Medicinal  
 Chemistry  
 Process Engineering Co-op  
 Product Manager (ATL)  
 Project Assistant  
 Project Coordinator (ATL)  
 Project Coordinator (ATL)  
 Promotions Manager  
 Purchasing Manager  
 QA Archive Coordinator  
 QA Documentation Coordinator  
 QC Inspector (ATL)  
 Quality Assurance Manager  
 Quality Assurance Manager  
 Quality Control  
 Quality Engineer  
 Radiotherapy Technical Specialist  
 Regional CRA / Senior CRA  
 Regulatory Affairs Specialist  
 Renal Sales Specialist  
 Research Assistant-Farm  
 Research and Development Co-op  
 Research Assistant I  
 Research Associate 1 (ATL)  
 Research Associate 2 (ATL)  
 Research Scientist  
 Research Scientist (ATL)  
 Research Technician  
 Retail Sales Representative  
 Sales Representative

Sales Representative  
 Sales Representative  
 Sales Specialist  
 Scientist  
 Scientist  
 Senior Assay Scientist - Manager, Assay  
 Systems  
 Senior Certified Technician  
 Senior Director, Clinical Operations  
 Senior Health Physics Technician  
 Senior Manager, Compensation (ATL)  
 Senior Manager, Formulation  
 Development  
 Senior Mechanical Engineer  
 Senior Position, Nucleoside Research  
 (PhD) (ATL)  
 Senior Research Engineer  
 Senior Scientist-Medicinal Chemistry  
 Sr. Manager, CMC Regulatory Affairs  
 Supervisor, Quality Assurance, North  
 American Distribution  
 Supervisor, Serum Processing  
 Supervisor-Quality Control and Training  
 (ATL)  
 Supply Chain Specialist (ATL)  
 Synthetic Organic Chemist (ATL)  
 Systems Programmer  
 Systems Specialist  
 Technical Sales Engineer  
 Technical Service Specialist (ATL)  
 Telesales Representative/ 11 (ATL)  
 Transportation Analyst (ATL)  
 Treatment Planning Technical Specialist  
 Ultrasound Applications Specialist  
 Unit Specialist  
 Validation Specialist  
 Validation Technologist  
 Veterinary Specialist/ 5  
 VP Marketing

Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

## **Appendix III**

# **Companies in the metro Atlanta and state bioscience directories advertising job openings in January 2003**

Company Name	#
Abbott Laboratories	3
Altea Development Corp.	2
Ana-Gen Technologies, Inc.	2
AtheroGenics, Inc.	3
AviGenics	1
CardioMEMS, Inc.	5
Chiltern International	1
CIBA Vision	3
Clinimetrics	2
Elan	8
Elektra	11
EPD International, Inc.	1
Gene Cure LLC	1
Immucor	5
Inhibitex Inc.	1
Kiel Pharmaceuticals, Inc.	3
Kimberly-Clark Corp.	4
MD Works, Inc.	2
Merial, Ltd.	19
Mikart, Inc.	3
Monsanto Company	10
NuTech Sciences	1
Pharmasset, Inc.	3
Porex Surgical, Inc.	1
ProLinia, Inc.	2
Quest Diagnostics	6
Quintiles	10
Rusch, Inc.	1
Serologicals Corp.	8
Siemens Medical Systems, Inc.	1
Silliker, Inc.	2
SpectRx, Inc.	3
Theragenics Corp.	3
Toshiba America Medical Systems (TAMS)	4
UCB Pharma, Inc.	8
Valen Biotech, Inc.	3
Wingo	1
Company name not specified	1

Source: Georgia Tech survey of 160 life science openings, January/February 2003. Of 279 life science companies in Georgia, 48 had advertised job openings.

## **Appendix IV**

# **Mean Wages by Bioscience Occupation: Georgia and U.S.**

SOC	Occupation Name	Georgia			United States		
		Mean Annual Wages	Relative Standard Error	Number of Survey Respondents	Mean Annual Wages	Relative Standard Error	Number of Survey Respondents
17-2031	Biomedical Engineers	\$53,510	3.1%	80	\$63,330	1.5%	6,960
17-2041	Chemical Engineers	\$69,820	1.2%	750	\$72,780	1.7	31,710
19-1010	Agricultural and Food Scientists	\$49,850	2.8%	5	\$49,710	0.5%	13,470
19-1021	Biochemists and Biophysicists	\$56,360	11.0%	70	\$61,680	1.7%	16,130
19-1022	Microbiologists	\$55,840	6.3%	590	\$54,500	1.7%	15,520
19-1042	Medical Scientists, Except Epidemiologists	\$56,590	4.7%	320	\$62,650	2.8%	46,430
19-2031	Chemists	\$56,820	1.6%	1,610	\$55,880	1.1%	84,870
19-4011	Agricultural and Food Science Technicians	\$28,990	2.2%	220	\$29,750	1.4%	17,310
19-4021	Biological Technicians	\$31,250	2.6%	790	\$34,030	60.0%	43,560
19-4031	Chemical Technicians	\$31,730	1.6%	1,900	\$37,850	80.0%	71,000
25-1052	Chemistry Teachers, Postsecondary	\$60,070	5.1%	260	\$58,390	1.2%	16,610
29-2011	Medical, Clinical Lab Technologists	\$40,540	0.90%	4,340	\$43,060	0.40%	145,400
29-2012	Medical, Clinical Lab Techs	\$25,400	1.5%	4,540	\$30,200	0.4%	146,920
31-9093	Medical Equipment Preparers	\$21,700	1.5%	1,000	\$23,490	1.0%	33,540

Based on surveys of 1.2 million nonfarm establishments.

Source: 2001 Occupational Employment Statistics Survey, U.S. Bureau of Labor Statistics.

## **Appendix V**

# **Executive Interview Protocol**

*Life Sciences Supply/Demand Study – Georgia Tech/State Board of Regents/Metropolitan Atlanta Chamber of Commerce*

*Protocol for Biotech Firm Executive Interviews: Final*

**Internal Note:** *Approx 15-20 surveys of a combination of small and larger size firms will be conducted through live interviews, either in person or via conference call. Target interviewees are heads of firms or HR personnel who have responsibility and authority for major hiring decisions. Survey instrument is for interviewer's use only.*

**Interviewer's brief intro:** "Georgia seeks to improve your experience and opportunities for doing business in Georgia by enhancing the state's human resource and education capabilities. Thank you for your time. Your insights will help us learn about your industry's human resource and educational needs and issues and how Georgia can better meet those needs."

## **1. Company Overview**

1. First, can you tell me about your company and its Georgia operations?

<b>Question</b>	<b>Response</b>
1a. Company function (probe also for functions conducted in Ga)	1a. (e.g., HQ/Back office/Mfg/R&D/Product Development/Sales/Other – list)
1b. Headquarters location	1b.
1c. Describe other locations/facilities	1c.
1d. Number of employees	1d. Ga – US – Worldwide –
1e. Where are hiring decisions made?	1e.

## **2. Issues**

What would you say are the greatest human resource problems facing your company?



### 3. Current Hiring Experiences in Georgia

#### Past 12 months

3a1. What were the primary job titles of personnel that you hired in the past 12 months?

3a2. How many new non-administrative employees did you hire in the past 12 months?

3a3. From what sources were they hired? From what geographic areas? (Probe: do you use local recruiters, etc.)

3a4. What were the educational requirements for these jobs?

3a5. What were the experience requirements for these jobs?

#### Past 12 Months (record answers)

Job titles (3a1, 3a2)	Number (3a1, 3a2)	Sources/Areas (3a3)	Education (3a4)	Experience (3a5)

#### Next 12 months

3b1. What occupations or positions are you planning to fill over the next 12 months (probe to get specific job titles)

3b2. How many people are you planning to hire in the next 12 months? (probe to determine whether this is a growth or stability position)

3b3. What sources do you plan to use to fill these jobs? What geographic areas?

3b4. What are the educational requirements for these jobs?

3b5. What are the experience requirements for these jobs?

### **Hiring Needs Next 12 months (record answers)**

<b>Job titles (3b1)</b>	<b>Number (3b2)</b>	<b>Sources/Areas (3b3)</b>	<b>Education (3b4)</b>	<b>Experience (3b5)</b>

#### **Unfilled Positions**

3c1. Does your firm currently have unfilled, full-time core positions? If yes, what are these positions?

3c2. What are the reasons for these positions being unfilled?

3c3. What impact have these unfilled positions had on your company's business? (Probe: how does the work get done?)

3c4. Is there significant local competition for any particular skill set? (Probe for list of skill sets under competition)

3c5. Do you face major competition for labor resources? (Probe for types of labor resources)

3d1. Did personnel in core positions leave your firm in 2002? (Probe: What were the job titles/positions of these persons? Why did these persons leave?)

#### **4. Labor Availability and Cost**

4a. Are there any current or potential skill area shortages in this market? If so, in what occupations are these shortages?

- Probe for specific occupations (e.g., clinical research associates for drug trials, biostatisticians) or
- Probe for occupational areas such as scientists/researchers, technicians, engineers, managers, regulatory/clinical affairs, finance/marketing, production, lab workers

4b. Is there a surplus of talent in a particular field? If so, please describe the areas in which these surpluses exist (probe for fields, occupations, or experience levels)

4c. What do you think of the quality of entry-level talent in Georgia? Would you rate the entry-level talent good, adequate/average, or poor? [ ] Good [ ] Adequate/average [ ] Poor

4d1. Do you have problems with wage scales in attracting key employees? If so, please describe.

4d2. How important are wages in retaining employees? If they are important, what types of employees (titles/areas) are retained based on high wages?

4e. Are employees leaving for opportunities out of state? If so, please describe (e.g., types, titles, occupational areas of employees)

4f. Which biotechnology-related occupations are likely to have the greatest unmet needs in Georgia in 3-5 years?

## **5. Recruitment**

5a. What types of recruiting challenges does your firm face?

5b1. Are you able to fill positions locally?

5b2. Are there any skill areas or types of positions that are difficult to fill locally? If yes, please describe.

5c. What cities does Georgia compete with for recruitment of biotechnology specialists?

- Probe: what advantages does Georgia have over these cities? What are Georgia disadvantages?
- What can the city or state do to make Georgia more attractive for recruiting biotechnology specialists?

5d1. Do you recruit at Georgia universities? If yes, which universities?

5d2. Do you do any recruiting of any of the following types of university students?

☐ Interns or co-ops ☐ Bachelors ☐ Masters ☐ Ph.Ds.

5d3. Are there any university degree programs you would like to see augmented or improved? If yes, please indicate programs.

5e1. Do you recruit at Georgia technical colleges or two-year community colleges? If yes, which technical or community colleges?

5e2. Are there any technical or community college degree or certificate programs you would like to see augmented or improved? If yes, please indicate programs.

5f. How interested would your firm be in providing financial or other types of resources to partner with Georgia's colleges and universities? Probe for particular colleges and universities; probe for particular programs.

**6. Do you have any additional comments about how the state (through its colleges and universities) can support you in meeting your human resources needs?**

7. Additional comments (probe for regulatory and quality assurance issues if not previously discussed)

That's all the questions we have today. May we come back to you if we need more information?

☐ Yes ☐ No

Thank you for your time and assistance.