

**DRAFT**

## **National Trends in Biotechnology Technician Education**

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**Bio-Link Survey Analysis Update 2005**

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This project was supported, in part, by the National Science Foundation. Opinions expressed are those of the authors and not necessarily those of the Foundation.

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**NSF Awards DUE-9850325, DUE-0118933, DUE-0402139**

Suggested citation: Hershbell Charles, K. & Johnson, E. A. (2005). *National trends in biotechnology education: Bio-Link survey analysis update 2004*. San Francisco: Bio-Link.

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## I. Introduction & Acknowledgments

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This update provides a review of 1999–2000 data that Bio-Link has collected through its national survey. In this current analysis, we compare selected findings to those of the 1998–99 data collected in the spring of 2000 from 47 biotechnology programs nationwide.<sup>1</sup> The follow-up survey on which we base this report collected data from 67 biotechnology programs, representing an 86 percent response rate of the 77 active, formal programs we surveyed. All programs responded to the survey via the Internet (<http://www.bio-link.org/login.htm>); collecting data in this way allows Bio-Link to provide a searchable, online directory of biotechnology programs that designated contacts can update by simply logging in and entering information. This information is then immediately available through the Internet-based directory.

After conducting the original national survey, we determined it necessary to change a number of questions to elicit more meaningful responses. In addition, we reduced the number of required questions to only those that we anticipate are likely to fluctuate from year to year (e.g., contact information, student demographics and reasons for enrollment). In some cases, this has limited our ability to compare data longitudinally. Respondents still have the option of updating the other, less variable, data.

**Acknowledgments.** Bio-Link has collaborated with several organizations and a number of individuals in developing the survey and obtaining and analyzing results. The Bio-Link Regional Directors and Mary Pat Huxley, Director of the State Biological Technologies Initiative in California, assisted in requesting programs to respond to the survey. Katrina Brink, consultant to Bio-Link, made numerous phone calls to program directors to increase our response rate. Graham Charles of Ars Indicii Information Design created the architecture for the online survey and database (from which the searchable online directory draws information) and provided statistical summaries. Sonia Wallman and Tim Dubuque at the Northeast Regional Center (housed at New Hampshire Community Technical College) maintain the Bio-Link Web site through which respondents access the survey. We are grateful to these individuals for contributing their time and talents to advancing our knowledge of biotechnology training programs.

In addition, we would like to thank the following programs who participated in this survey and who contribute tremendously to educating the biotechnology workforce:

- Alamance Community College, Graham, North Carolina
- Amarillo College, Texas
- American River College, Sacramento, California
- Anoka-Ramsey Community College, Coon Rapids, Minnesota
- Athens Technical College, Georgia
- Austin Community College, Texas
- Bakersfield College, California
- Baltimore City Community College, Maryland
- Bates Technical College, Tacoma, Washington

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<sup>1</sup> When preparing the initial report, we received information from 70 colleges nationwide and determined that, at that time, 47 of those colleges had active, formal programs with data available for 1998-99.

- Central Carolina Community College, Sanford, North Carolina
- Chattahoochee Technical Institute, Marietta, Georgia
- City College of San Francisco, California
- CityLab Academy, Boston University School of Medicine, Massachusetts
- College of the Canyons, Santa Clarita, California
- Community College of Southern Nevada, Las Vegas, Nevada
- Contra Costa College, San Pablo, California
- County College of Morris, Randolph, New Jersey
- Delaware Technical and Community College, Newark, Delaware
- Delta College, University Center, Michigan
- Des Moines Area Community College, Des Moines, Iowa
- Ellsworth College, Iowa Falls, Iowa
- Finger Lakes Community College, Canandaigua, New York
- Foothill College, Los Altos Hills, California
- Frederick Community College, Maryland
- Indian Hills Community College, Ottumwa, Iowa
- Kapiolani Community College, Honolulu, Hawaii
- Kennebec Valley Technical College, Fairfield, Maine
- Kirkwood Community College, Cedar Rapids, Iowa
- Lakeland Community College, Kirtland, Ohio
- Laney College, Oakland, California
- Lansing Community College, Michigan
- Madison Area Technical College, Wisconsin
- Merced College, California
- Middlesex Community College, Bedford, Massachusetts
- Middlesex Community College, Middletown, Connecticut
- MiraCosta College, Oceanside, California
- Miramar College, San Diego, California
- Mississippi Gulf Coast Community College, Gulfport, Mississippi
- Monroe Community College, Rochester, New York
- Montgomery College, Conroe, Texas
- Montgomery College, Germantown, Maryland
- Moorpark College, California
- Naugatuck Valley Community College, Waterbury, Connecticut
- New Hampshire Community Technical College, Portsmouth, New Hampshire
- North Shore Community College, Danvers, Massachusetts
- Northern New Mexico Community College, Española, New Mexico
- Ohlone College, Fremont, California
- Oklahoma City Community College, Oklahoma
- Pasadena City College, California
- Piedmont Virginia Community College, Charlottesville, Virginia
- Portland Community College, Oregon
- Salt Lake Community College, Utah
- San Diego City College, California
- San Diego Mesa College, California
- Santa Barbara City College, California
- Santa Fe Community College, Gainesville, Florida
- Santa Monica College, California

- Seattle Central Community College, Washington
- Shoreline Community College, Seattle, Washington
- Skyline College, San Bruno, California
- Solano College, Suisun, California
- Southwestern College, Chula Vista, California
- St. Louis Community College - Florissant Valley, Missouri
- The Community College of Baltimore County, Catonsville, Maryland
- Ventura College, California
- Vermont Technical College, Randolph Center, Vermont
- Victor Valley College, Victorville, CA

Please note that, at the time of this survey, at least six additional colleges provided biotechnology training and either did not have formal degree programs or were too new at the time of the survey to provide data. Thus, during 1999-00, at least 16 additional colleges (including those that did not respond to the survey), were offering biotechnology training to varying degrees but were not included in this report, except where noted.

## II. The Evolution of Community & Technical College Biotechnology Education

In 1998-99, we reported that 49 active, formal biotechnology education programs were located in community and technical colleges throughout the nation. Based on our findings, it appears that the number of these active, formal programs increased by 57 percent in the subsequent year. That is, our latest data collection revealed that 77 formal programs were actively training students for careers in biotechnology during 1999-00.

Table 1  
Community & Technical College Biotechnology Program Locations,  
Comparison of 1998-99 to 1999-00<sup>2</sup>

Region	State(s) within Region That Have Programs	Number of Programs by State, 1998-99	Number of Programs by State, 1999-00	Number of Programs by Region, 1998-99	Number of Programs by Region, 1999-00
Northeast	Connecticut	1	2	13	17
	Delaware	0	1		
	Maine	1	1		
	Maryland	3	4		
	Massachusetts	4	4		
	New Hampshire	1	1		
	New Jersey	1	1		
	New York	1	2		
	Vermont	1	1		
North Central	Illinois	1	1	8	11
	Iowa	3	4		
	Michigan	2	2		
	Minnesota	0	1		
	Missouri	0	1		
	Ohio	1	1		
	Wisconsin	1	1		
Northwest	Montana	1	1	5	5
	Oregon	1	1		
	Washington	3	3		
Northern California & Southwest	California	15	28	15	31
	Hawaii	0	1		
	Nevada	0	1		
	Utah	0	1		
South Central	Colorado	1	1	4	7
	New Mexico	1	1		
	Oklahoma	1	1		
	Texas	1	3		
Southeast	Florida	0	1	4	6
	Georgia	1	2		
	Mississippi	1	1		
	North Carolina	2	2		
	Virginia	0	1		
<b>Total</b>		<b>49</b>	<b>77</b>		

All regions experienced growth in the number of biotechnology training programs, with the exception of the Northwest region. California exhibited the largest increase in the number of new programs. States in which no programs had existed in 1998-99 but in which new programs had emerged in 1999-00 include Delaware, Florida, Hawaii, Minnesota, Missouri, Nevada, Utah, and Virginia.

<sup>2</sup> Please note that this table includes programs not included in the remainder of the survey analysis.

Based on our survey findings, we have estimated the total number of students enrolled in these programs to have increased from 1,075 in 1998-99 to 1,868 in 1999-00, a nearly 74 percent increase.

These increases mirror substantial growth in the biotechnology industry, at least as measured by increases in the number of biotechnology companies.<sup>3</sup>

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<sup>3</sup> This survey does not substantiate this parallel, but anecdotal evidence suggests that there has been an increase in the demand for entry-level employees. Conversations with observers of the industry suggest that this demand is driven in part by the shift of many companies from research and development activities to manufacturing and the broader definition of the industry to include industries such as medical devices, to name but only one example. The parallels in these growth trends—those of the community and technical college biotechnology programs and those of the biotechnology industry—suggest that community and technical colleges are highly responsive to their local industry needs.

### III. The Community & Technical College Biotechnology Student

**Student Demographics.** The typical age of biotechnology students reported by colleges in 1999-00 is 26, only slightly lower than that reported in 1998-99, which was 27; students in 1999-00 ranged in age from 17 to 69, roughly the same as in 1998-99 (which we reported as 16 to 72). The percentage of female students remains the same at 62 percent.

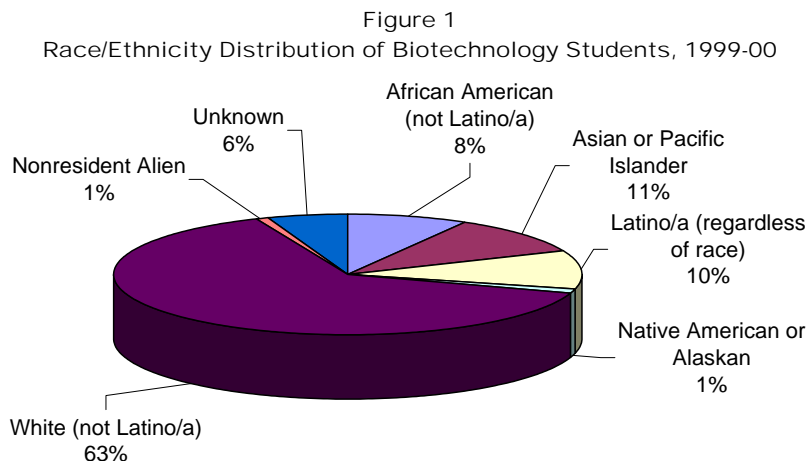


Table 2  
Race/Ethnicity Distribution of Biotechnology Students  
Including Comparison of 1998-99 to 1999-00 &  
Comparison of Biotechnology Program Enrollment to Overall College Enrollment<sup>4</sup>

Race/Ethnicity	1998-99 Biotechnology Program Average, Percent (%)	1999-00 Biotechnology Program Average, Percent (%)	1999-00 Survey Sample College Average, Percent (%)	1997 General Community College National Average, Percent (%) <sup>5</sup>
African American (not Latino/a)	10	8	10	11
Asian or Pacific Islander	13	11	11	6
Latino/a (regardless of race)	10	10	16	12
Native American or Alaskan	2	1	2	1
<b>Minority Subtotal<sup>6</sup></b>	<b>35</b>	<b>30</b>	<b>39</b>	<b>30</b>
White (not Latino/a)	66	64	55	65
Nonresident Alien	–	1	1	4
Unknown	–	6	5	2

<sup>4</sup> Note about changes to this survey question: During the 1999-00 round of data collection, we added a question that asked respondents to provide figures for the distribution of race and ethnicity across their colleges. This is represented by the column labeled, “1999-00 Survey Sample College Average, Percent (%)” We also allowed respondents to include “Nonresident Alien” and “Unknown” which may have affected the outcome of these findings. More specifically, respondents originally may have guessed more at students’ ethnicity but were now able to enter “Unknown.” Thus, “Nonresident Alien” and “Unknown” may include additional minority students who were not captured in the traditional minority categories, which would yield a larger percent of minority students. Future data collection will allow us to detect whether a downward trend is indeed present with respect to minority enrollment.

<sup>5</sup> Source: Phillippe, K. A. & Patton, M. (1999). *National profile of community colleges: Trends and statistics. 3<sup>rd</sup> edition.* Washington, DC: American Association of Community Colleges.

<sup>6</sup> Note that the minority subtotal includes the category “Asian or Pacific Islander” which combines individuals who are well-represented in the sciences from certain Asian countries (e.g., Japan) with those individuals from Asian countries who are underrepresented in the sciences (e.g., Pacific Island nations or Asian countries such as Vietnam).

As Figure 1 and Table 2 indicate, in general, the distribution of enrollment by ethnicity in biotechnology programs has generally held steady, although the overall enrollment of minority students appears to have decreased slightly (35 percent in 1998-99 compared to 30 percent in 1999-00).<sup>7</sup> White students continue to make up the majority of the biotechnology student population. Students enrolled in biotechnology programs in 1999-00 do not appear to be as diverse those enrolled in the colleges surveyed (based on self-reported data), yet these students generally mirror the diversity of the community and technical college population as reported by Phillippe and Patton in 1999 (see footnote 2). It appears that the lower percentage of minority students in these programs overall is largely due to fewer numbers of Latino students.

**Student Origin.** Generally, the percent of students entering biotechnology from various origins during 1999-00 remained relatively consistent with 1998-99. The percent of students entering from high school increased modestly from 23 percent in 1998-99 to 25 percent in 1999-00, aligning with the slight decrease in the average age of students (see above). Slight decreases occurred in the percent of students entering from another program within the same college, those entering from other colleges, and those entering from a four-year program or post-graduate institution.

Figure 2  
Origin of Students Entering Community & Technical College Biotechnology Programs, 1999-00

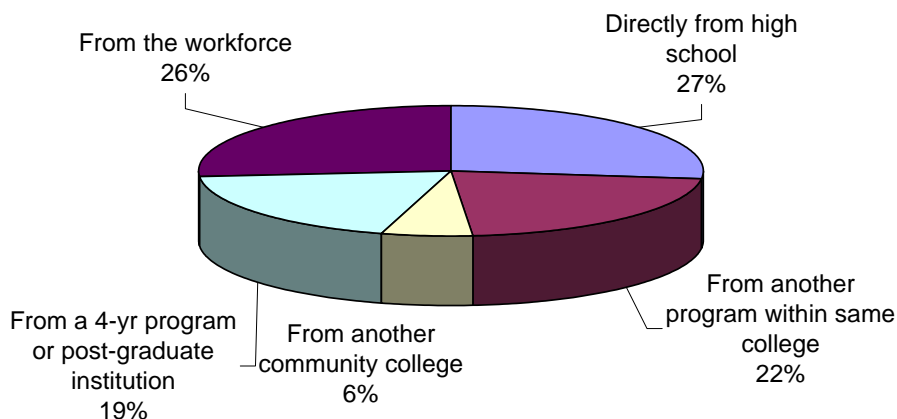


Table 3  
Origin of Students Entering Community & Technical College Biotechnology Programs  
Comparison of 1998-99 to 1999-00<sup>8</sup>

	1998-99		1999-00	
	#	%	#	%
Students entering directly from high school	247	23	467	25
Students entering from another program within same college	247	23	392	21
Students entering from another community college	86	8	112	6
Students entering from a 4-year program or post-graduate institution	237	22	336	18
Students entering from the workforce	-	-	467	25

**Student Motivation to Enroll in Biotechnology Programs.** Between 1998-99 and 1999-00 the percentage of students enrolled to prepare for employment in biotechnology for the first time dropped considerably from 76 percent to 45 percent. However, what is consistent about these figures is that, in each year, this category remained the most popular reason that students enrolled in biotechnology programs. Overall, the figures for 1999-00 in all cases are lower than those of 1998-99 (see note

<sup>7</sup> See comments following Figure 1 and Table 2.

<sup>8</sup> Note about changes to this survey question: In the 1999-00 survey, we added a new question about the number of students entering from the workforce and forced the responses to total 100 percent (note that the 1998-99 responses exceed 100 percent when totaled, suggesting that respondents did not view these categories as mutually exclusive). Thus, these findings may or may not suggest any trends given that we modified the question slightly. We will know more as we monitor these statistics in future years.

below). That is, fewer students appeared to enroll in biotech programs to change careers (32 percent in 1998-99 and 13 percent in 1999-00). Likewise, fewer students appear to have enrolled during 1999-00 for the purpose of fulfilling requirements for transfer to a four-year institution (31 percent in 1998-99 and 24 percent in 1999-00).

Figure 3  
Student Motivation for Biotechnology Enrollment,  
Average Percent, 1999-00

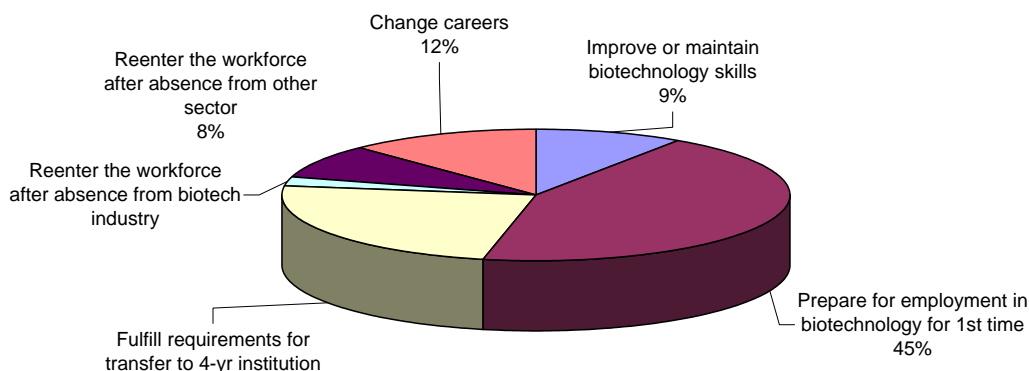


Table 4  
Student Motivation for Biotechnology Enrollment,  
Average Percent, Comparison of 1998-99 to 1999-00<sup>9</sup>

	1998-99	1999-00
Percent (%) of students enrolled to improve or maintain biotechnology skills	14	10
Percent (%) of students enrolled to prepare for employment in biotechnology for the first time	76	45
Percent (%) of students enrolled to fulfill requirements for transfer to a 4-year institution	31	24
Percent (%) of students enrolled to reenter the workforce <b>after an absence</b> from the <b>biotechnology industry</b>	–	2
Percent (%) of students enrolled to reenter the workforce <b>after an absence</b> from a <b>non-biotechnology sector</b>	–	9
Percent (%) of students enrolled to change careers (currently working in a non-biotechnology sector)	32	13

<sup>9</sup> Note about changes to this survey question: As with many of the survey questions, we modified this question such that it included the percent of students enrolled to reenter the workforce after an absence from the biotechnology industry and after an absence from the non-biotechnology sector. Changing this question included forcing the total to equal 100 percent, which had not been the case in the first data collection (note that the total for 1998-99 exceeds 100 percent). Longitudinal data over time will shed more light on these statistics.

**Employment & Transfer.** Table 5 provides an overview of the number of students enrolled in biotechnology programs at community and technical colleges throughout the nation in addition to what happens to these students upon exiting these programs. As noted in the beginning of this report, the number of students enrolled in biotechnology programs has increased from 1,075 in 1998-99 to 1,868 in 1999-00, a nearly 74 percent increase.

Table 5  
 Employment & Transfer of Students  
 Exiting Community & Technical College Biotechnology Programs  
 Comparison of 1998-99 to 1999-00<sup>10</sup>

	1998-99	1999-00
Number of students enrolled	1,075	1,868
Number of students who graduated with an Associates Degree	254	458
Number of students who graduated with a certificate	232	296
Number of students who transferred to a four-year institution	156	317
Number of <b>graduates</b> who accepted <b>full-time</b> employment	248	758
Number of <b>graduates</b> who accepted <b>part-time</b> employment	92	85
Number of students who did not graduate but <b>completed their goal</b> ("non-graduate completers")	–	1,051
Number of <b>non-graduate completers</b> who accepted <b>full-time</b> employment in industry	–	653
Number of <b>non-graduate completers</b> who accepted <b>part-time</b> employment in industry	–	85
Number of <b>non-graduate completers</b> who <b>transferred</b> to four-year institutions	–	272

A slightly smaller proportion of students (16 percent) graduated with a certificate in 1999-00 in comparison to 1998-99 (22 percent). A larger proportion of graduates accepted full-time employment (41 percent in 1999-00 compared to 23 percent in 1998-99). At the same time, a smaller percentage of graduates accepted part-time employment in 1999-00 (5 percent) than in 1998-99 (9 percent). These figures are estimates; the subsets presented here may overlap. However, the trends, as captured in the proportion of the whole, provide interesting comparative—albeit approximate—information.

Average entry salary for students exiting biotechnology programs in 1999-00 was \$26,097, up 2 percent from 1998-99 (reported as \$25,601). After two years of employment, respondents estimated average salaries to rise to \$32,273, a 24 percent increase from the average starting salary. This figure substantiates the anecdotal observation of many program directors that graduates advance rapidly with respect to salary increases once they are employed within industry. We believe that this estimate is conservative; what it does not capture is the ability for technicians to work over-time hours and "graveyard" shifts, nor does it factor in potential benefits such as stock options and support for further education.

<sup>10</sup> Note about changes to this survey question: The 1998-99 survey did not capture the fact that a significant percent of students do not have the goal of attaining a certificate, degree or transferring to a four-year institution but instead enter biotechnology programs to gain skills for employment as soon as possible (often before completing a certificate or degree). We amended the 1999-00 survey to capture this information in the form of "non-graduate completers" as presented in Table 4.

## IV. The Community & Technical College Biotechnology Instructor

**Types of Instructors.** The types of community and technical college faculty did not appear to have changed between 1998-99 and 1999-00. On average, programs employ the same number of full-time faculty as they do part-time faculty and rely heavily on outside instructors (primarily individuals working in industry) to supplement instruction. This figure may be skewed given that some programs hire appreciably larger numbers of instructors from industry (including commercial industry, academic research institutions, or government laboratories) than most colleges on average. By removing the college that reported hiring as many as 50 instructors from outside the college from the analysis, the average number of instructors employed primarily outside the college is four (4), still exceeding the number of staff employed within the college, whether part- or full-time, and the range of the number of outside instructors is 0 to 18, which is more in line with the number of part-time faculty.

Figure 4  
Types of Instructors, 1999-00

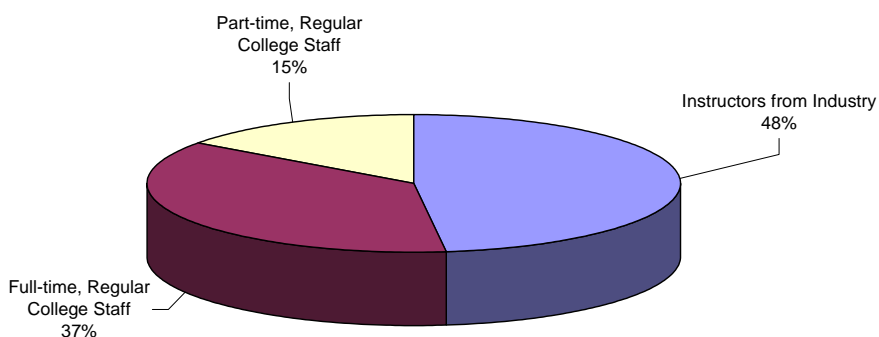
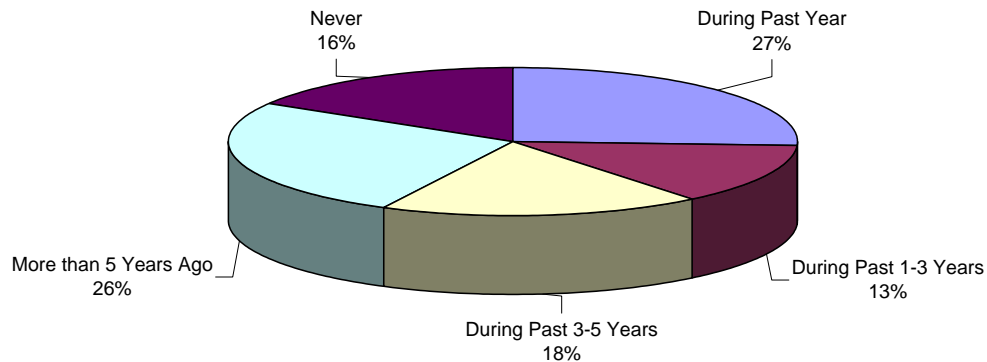


Table 6  
Types of Instructors,  
Comparison of 1998-99 to 1999-00

Type of Instructor	Mean Number of Instructors, 1998-99	Mean Number of Instructors, 1999-00	Range Number of Instructors, 1998-99	Range Number of Instructors, 1999-00
Full-time, regular college staff	2	2	1 to 13	0 to 12
Part-time, regular college staff	3	2	1 to 22	0 to 6
Instructors from Industry	7	7	1 to 50	0 to 50

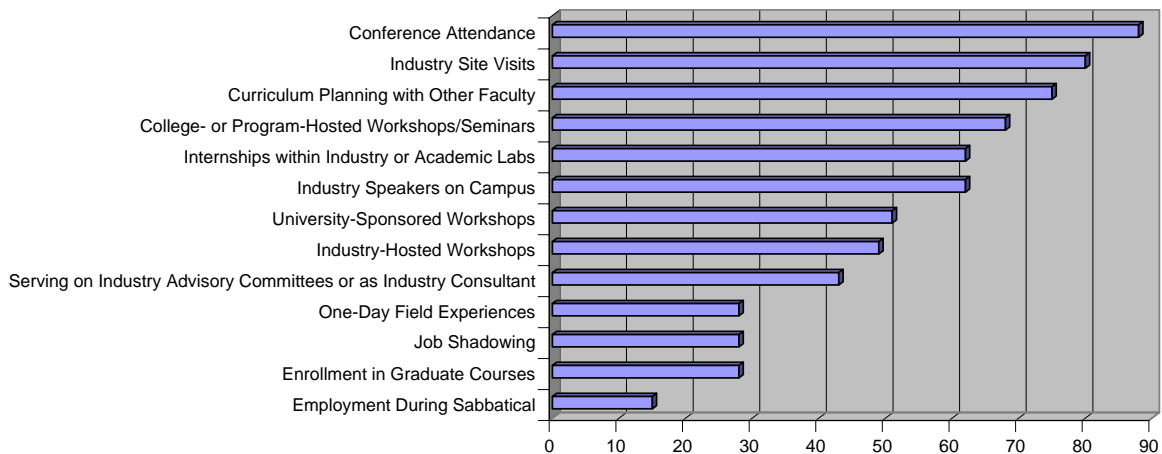
**Faculty Background.** While 39 percent of programs reported in 1999-00 that their faculty had industry experience within the past three years, 26 percent reported that their faculty had only had industry experience more than five years ago and 16 percent reported that their faculty had never had industry experience (up from 10 percent in 1998-99). Given the rapidly changing technology in this industry, this finding suggests that a large number of community and technical college faculty may be in need of professional development within industry settings (see also section entitled “Professional Development” below).

Figure 5  
Most Recent Faculty Experience in Industry, 1999-00<sup>11</sup>



**Faculty Development.** The majority of instructors (82 percent) in biotechnology programs engage in professional development activities.<sup>12</sup> Professional development activities include: conference attendance (reported by 88 percent of respondents), site visits to industry (80 percent), curriculum planning with other faculty (75 percent), college- or program-hosted workshops or seminars (68 percent), industry speakers on campus (62 percent), and internships within industry or academic research laboratories (62 percent).

Figure 6  
Types of Faculty Development, 1999-00



<sup>11</sup> Note about changes to this survey question: During 1998-99, we framed this question differently such that we are unable to provide a comparison between the two years as we have with other data.

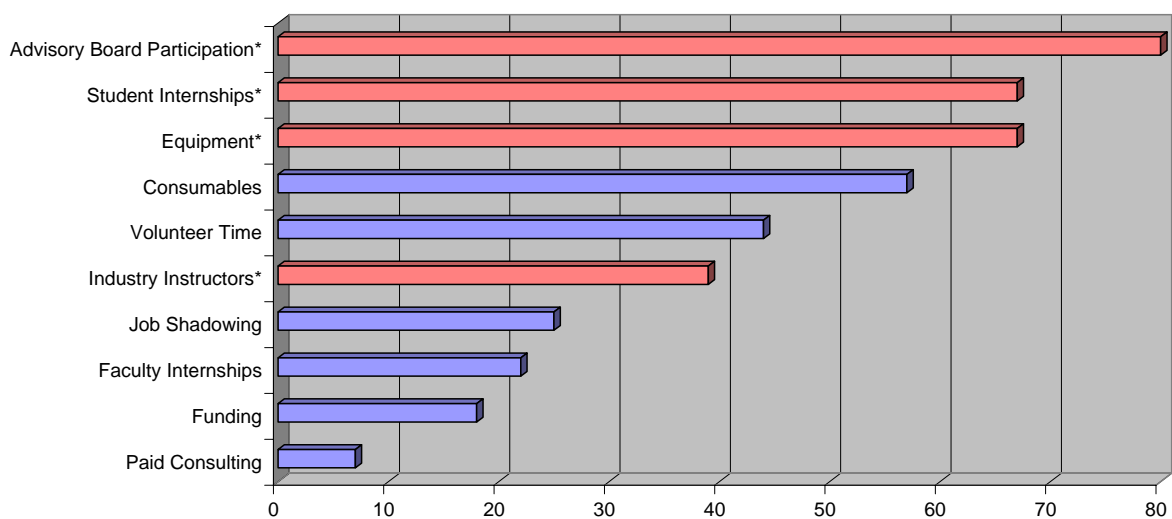
<sup>12</sup> We do not have comparative data from 1998-99 for the percentage of instructors who participated in professional development given that we did not ask this question at the time of the original survey.

## V. The Community & Technical College Biotechnology Program

We collected information on many other aspects of community and technical college biotechnology programs during 1999-00. However, we determined that the most relevant information—and the information most likely to change from year to year—was that of industry support. Figure 6 below summarizes the most common types of support that industry provides to community and technical college biotechnology programs and indicates which types of support are perceived to be most important. The most common type of support (reported by 80 percent of programs) is advisory board participation. Student internships and equipment donations represent another common type of support with 67 percent of community and technical college programs listing these forms of support. Few programs (7 percent) pay industry for non-instructional consulting services; similarly, relatively few programs (18 percent) receive funding from industry as a form of support.

According to respondents, the most important types of industry support include advisory board participation, student internships, equipment, and industry instructors.

Figure 7  
Types of Industry Support, 1999-00



Note: Respondents, on average, ranked those items marked by an asterisk (\*) as the most important forms of support.

## VI. Conclusions & Closing Remarks

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The information obtained from the surveys identifies issues for national discussion about ways that community and technical colleges build programs and courses that serve students seeking career preparation for employment in the biotechnology industry. Not only are the biotechnology companies varied in size and focus, but students wishing to obtain job skills hail from varied backgrounds. Meeting the skill needs of industry as well as servicing the wide range of backgrounds presents challenges for community and technical colleges for the provision of hands-on skills as well as transfer opportunities.

A recent addition to the skill standards documents is *Biotechnology & Biomedical Skill Standards, 2001*, funded through the Workforce Development Fund of the State of Washington. This document refers to the concern over the shortage of workers with the skills needed to keep pace with technology. Bio-Link seeks to find the most effective ways for community and technical colleges to create and sustain programs that meet biotechnology training needs. Our survey is one vehicle for tracking national trends and serves as a resource for growing appropriate programs.

Our data demonstrate a growing number of biotechnology programs at community and technical colleges in a number of regions nationwide where it may be the case that the biotechnology industry, according to local predictions, is expected to grow. Student enrollment in these programs is stable. While the representation of minority students in these programs generally mirrors that of the community and technical college population overall, we must continue to reach out to students who are under-represented in the sciences. An area in particular need of attention, according to the data we have collected, is that of professional development, particularly through industry internships for faculty. As programs grow, professional development will remain an ongoing need to assure quality programs and provide mechanisms for capacity building.

Bio-Link seeks to build partnerships with industry to support and sustain effective biotechnology skills-based training programs. We will distribute the results of this survey throughout the Bio-Link network of academic partners, industry professionals, and community-based organizations. We hope that the snapshot of biotechnology educational programs that are represented in this survey will provide useful information about design and delivery of skills for this rapidly growing and changing technological field. Moreover, we hope to generate discussion that will promote interest and information sharing about the resources at community and technical colleges. We will continue our data collection efforts such that we can provide greater insights into developing trends.