BIOTECHNOLOGY

Needs Assessment

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EXECUTIVE SUMMARY

- The field of biotechnology is rapidly expanding on the west and east coasts. However, growth is relatively limited in the Midwest and South. This is especially acute in southeastern Michigan as evidenced by our attempts to construct a list of firms who employed biotechnicians; nine companies were identified as hiring biotechnicians in our survey.

- Of those companies who do plan to hire biotechnicians over the next three to five years, only one firm planned to hire between six to ten biotechnicians, whereas five employers stated they would hire between one to five biotechnicians over the same time period.

- A salient issue for employers seemed to be the educational requirements and preferences which biotechnicians needed to be employed in the field. Half of the respondents suggested they would consider hiring an individual with an associate degree whereas the other half wanted a student with the minimum of a bachelor's degree.

- When asked what employers' preferred educational qualifications would be for a newly hired biotechnician, seven suggested a bachelor's degree and one employer stated they would be content with a master's degree in biology and chemistry. None of the employers surveyed chose an associate degree as the preferred option.

- We also surveyed companies to assess which technical skills they believed to be very important. The majority of firms suggested that employees should be very competent in following: complex protocols, troubleshooting and maintaining accurate records or logs. These three topics not only were the most frequently mentioned, but they also significantly outnumbered specific biotechnology competencies (i.e., plasmid purification and RNA experiments).

- Companies believed that internships were an important instrument in students' acquiring knowledge and skills in biotechnology. However, many employers thought the idea of an internship was more beneficial to students than it was for the host companies.

- Two biotechnology programs were identified at other higher educational institutions in Michigan. Ferris State University offers a four-year program in biotechnology. It is designed to prepare students for positions in biological, medical or agricultural research. In addition, Delta College has a pre-biotechnology program. Its intent is to prepare students to transfer to a four-year institution to complete their degree in biotechnology. It was not designed so that students could enter the workforce upon graduation from the program.

OAKLAND COMMUNITY COLLEGE

BIOTECHNOLOGY

Needs Assessment

INTRODUCTION

The purpose of this research is to review current industrial needs and educational requirements related to the field of biotechnology. Areas of employment include research and development, quality control, clinical research, manufacturing and production, regulatory affairs, information systems, marketing and sales, and administration. This report was initiated at the request of the biology faculty at the Orchard Ridge campus of Oakland Community College. The components of the report include a comprehensive literature review, data from the U.S. Department of Labor, information from the Dun and Bradstreet employer database, an analysis of other higher education biotechnology programs in the state and nation, and other relevant external information cited in the reference section of this study. Additional data were also acquired from phone interviews with businesses not only in southeast Michigan (Macomb, Monroe, Oakland, Washtenaw, and Wayne counties) but also in the Lansing, Flint, Jackson, and Toledo metropolitan areas. Including this geographical area was essential in obtaining a "critical mass" of employers who may have hired biotechnicians.

Part of the objective of this study was to assess those skills, competencies, and educational credentials companies consider essential for future employment opportunities. At the end of this report we attempt to answer the question: Is there an external demand for a two-year biotechnology program at OCC?

DESCRIPTION OF OCCUPATION

Biotechnology is still a relatively young and evolving field. The field is predicted to be one of the pivotal forces in the industry during the 21st century. Today, biotechnology is saving lives through the development of breakthrough drugs and improving the quality of life with new agricultural and environmental products. "The discipline is based on the ability of researchers to transfer specific units of genetic information from one organism to another" (Bidol, 1996). The process involves the integration of topics such as biochemistry, cell biology, chemistry, genetics, chemical engineering, process engineering and computer science. A biotechnician is an individual with the skills and knowledge required to work at the introductory level of biotechnology (Bidol, 1996). In most instances, a biotechnologist will direct the work of a biotechnician. A few examples of job responsibilities of a biotechnician include: combining bacteria and nutrients in petri dish, test and photograph them at intervals, spin them, separate DNA from cell nuclei and do simple digestion. They may also be responsible for a variety of scientific technical skills including, blotting, ELISA, cell/tissue culturing and plasmid purification.

METHODOLOGY

In order to obtain background information on biotechnicians, we conducted a literature review and gathered other relevant external information on the occupation. A complete listing of the references utilized is provided in the Reference section of this document.

We also conducted telephone surveys of companies to assess local employment opportunities, skill requirements, and future trends in the field. Employer names were obtained through the use of the Dun and Bradstreet MarketPlace software. The list was constructed through compiling names of firms within the targeted geographical area (i.e., metropolitan Detroit, Flint, MI, Lansing, MI, Jackson, MI and Toledo, OH). Standard Industrial Classification Codes (SIC) in the census were as follows:

Table 1 Standard Industrial Classification Codes

Number	*Division*
2099	Food Preparation
2812	Alkalies and Chlorine
2813	Industrial Gases
2834	Pharmaceutical Preparations
2833	Medicinal Chemicals and Botanical Products
2834	Pharmaceutical Preparations
2835	In Virto and In Vivo Diagnostic Substances
2836	Biological Products, Except Diagnostic Substances
2844	Perfumes, Cosmetics and other Toilet Preparations
2869	Industrial Organic
2879	Pesticides and Agricultural Chemicals, NEC
2899	Chemicals and Chemical Preparations, NEC
3841	Surgical and medical Instruments and Apparatus
3842	Orthopedic, Prosthetic and Surgical Appliances and Supplies
3851	Ophthalmic Goods
5169	Chemicals and Allied Products, NEC
8731	Commercial Physical and Biological Research
8732	commercial Economic, Sociological and Educational Research
8734	Testing Laboratories
8741	Management Services
8742	Management Consulting Services
8748	Consulting Services, NEC

Source: Dun & Bradstreet, MarketPlace, 1996

We constructed two different databases of companies to obtain names of organizations for the survey. The first dataset included 213 companies and the second list of names included 366 companies, for a total of 579 potential firms for our survey. (For a listing of the names of the companies who responded to our survey, please see Appendix A). Two different databases of company names were constructed because the first group (n=213) did not provide enough of a "critical mass" of organizations who hired biotechnicians. A second group (n=366) was developed with additional SIC codes which were not used in the previous dataset but had been utilized in the *Biotechnology Industry Training Needs for Southern California* (1995) prepared by the Resource Group. Their SIC codes were cross referenced with the first database SIC codes in order to prevent duplication. The SIC codes used in the second database included: 2099, 2812, 2813, 2833, 2836, 2869, 2879, and 8734. Only fifty-six companies were surveyed from the second group because answers from these companies substantiated and affirmed the majority of the responses from the first data set. Most employers did not hire biotechnicians. Of the 269 companies contacted for the survey, only nine firms stated that they hired biotechnicians.

EXTERNAL ANALYSIS

Employment Outlook

According to the U.S. Department of Labor, employment opportunities are expected to be very good for the industry as a whole through the year 2000. The Bureau of Labor Statistics reported a total of 231,000 "science technicians" (agricultural technicians, biological technicians, chemical technicians, nuclear technicians and petroleum technicians) working in 1994. Since the field of biotechnology is still relatively new, the U.S. government has yet to categorize it separately, hence their reference to "science technicians." In the biotechnology sector, 97,000 individuals were employed in 1993, and this number is expected to increase to over 105,000 by the year 2000 (BIA, 1994).

The Michigan Occupational Informational system (MOIS) did not contain information on biotechnicians in its central database. Thus, we could not make comparisons between state and national data.

One caveat on the growth of the biotechnology sector is that it is geographically specific. Currently there are 1,231 biotech companies operating within the U.S., which is an eleven percent increase over 1991 (Brown, 1994). Biotechnologists work mainly in the East and West. Comparatively few work in the Midwest or South. Major geographic centers of biotechnology firms across the country are listed in Table 2.

Table 2 Geographic Representation

Geographical Area	Number of Companies
San Francisco	181
New York	136
Boston	128
Washington, D.C.	115
San Diego	100
Los Angeles/Orange County	68
Texas	52
Seattle	48
North Carolina	46

Source: Brown, 1994

RESULTS

Industrial Categories

In the employer survey, we asked employers to identify their industry category and industrial classification. We asked that they choose all the responses that applied to their company in the industry/market category in case of any cross-over applications (Table 3) but limit their response to one classification in Table 4.

Table 3 Industry/Market Segment of Company

Section	*Number of companies*
Chemical	3
Biological Products	3
Environmental(bioremediation)	2
Human Diagnostic Substances	4
Agricultural	3
Supplier	2
Pharmaceutical Products	1
Food & Food Additives	1
Therapeutic methods	1
Other:	
Animal diagnostic	1

Source: Employer survey, 1996 n=9

We also wanted to know which industrial setting would best describe their market segment. Company responses to this question are indexed in Table 4.

Table 4 Industrial Settings of Respondents

Settings	*Number*
University, governmental, or nonprofit research organization	2
Research laboratory	3
Biotechnology laboratory	1
Other:	
Research and Manufacturing lab	1
Environmental consultants	1
Manufacturing facility	1

Source: Employer survey, 1996 n=9

Industrial Growth

As mentioned previously, the U.S. Department of Labor and the Biotechnology Industrial Association both concur that the field of biotechnology is expected to continue growing significantly through the year 2000. Nearly 80,000 people are employed in the biotechnology industry, which had more than $8.1 billion in revenues in 1992. This employment figure represents a 13 percent increase over previous years.

In our survey, we were interested in determining future opportunities for biotechnicians in our expanded geographic region. We asked employers how many new biotechnicians they planned to hire over the next three to five years.

Table 5 Predicted Need for Biotechnicians over the next 3 to 5 Years

Number of Needed Biotechnicians	*Number of Companies*
1-5	5
6-10	2
11-15	0
16-20	0
20 +	0
None	1
Missing	1

Source: Employer Survey, 1996 n=9

Five respondents stated they would hire between one and five individuals over the next three to five years. Two employers suggested that they would hire between six and ten, and one employer asserted they would probably not hire any biotechnicians within the next three to five year period. The missing response was provided by an organization which stated it was up to each faculty member to decide how many biotechnicians they needed.

In addition, the diversity of employers' opinions ranged from those who reported they did not have problems finding qualified employees (n=3) to those firms who frequently had problems (n=3) and those who sometimes had difficulty finding biotechnicians (n=1).

Table 6 Difficulty in Finding Qualified Biotechnicians

Response	*Number*
Never	3
Sometimes	1
Frequently	3
No Response	2

Source: Employer Survey, 1996 n=9

Skills

General Competencies

Employers were asked to comment on the importance of various skills needed in their industry. We first assessed those general competencies which employers believe are needed by employees in this field. Employers were asked whether newly hired biotechnicians were inadequately or adequately trained for various positions in their companies. Table 7 provides responses to the general skills "adequately trained" component of the questionnaire.

Table 7 - Employers Who Rated Their Employees' Skills as Adequate

Competencies	*Number Responding*
Basic Math	6
Communication	4
Critical Thinking	4
Decision-making	6
Organization skills	3
Prioritizing tasks	3
Computer literacy	5
Knowledge of safety & regulations	3
Problem solving	5
Teamwork	4
Responsibility/integrity/honesty	5
Work ethic	4

Source: Employer survey, 1996 *n=6*

It is also important to note that employers had the opportunity not to respond to any of the skill indicators. Three employers did not answer any portion of the survey for various reasons.

Technical Competencies

Employers were also asked about the technical skills they required when considering the employment of new biotechnicians. We attempted to determine whether employers believed the technical skills needed were very important, somewhat important or not important (See Table 8). The survey classified these skills under four competencies: protein/enzyme, DNA/RNA, additional technical, and other. As in the last survey question, employers had the opportunity not to respond to any of the indicators. Only one employer declined to give a response because of the length of the question.

Table 8 Employers Rating Technical Skills "Very Important"

Competencies	*Number Responding*
Protein/Enzyme	
Isolate, identify and label proteins	4
Protein determination	3
DNA/RNA	
Sequencing	3
Isolate, identify and label nucleic acids	3
Sizing of DNA	3
Mapping of DNA	2
Qualification of DNA	2
Plasmid Purification	1
Restriction digests/Plasmid digestion	2
Hybridization	3
RNA experiments	1
Basic cloning techniques	2
DNA/RNA amplification	2
Additional	
Blotting	2
ELISA	4
Cell/Tissue culturing	2
Standard microbiological techniques	3
Immunological techniques	3
Assays	4
Other	
Inventory and supply maintenance	0
Following complex protocols	6
Troubleshooting ability	7
Maintaining accurate records/logs	8

Source: Employer survey, 1996; n=8

We gave employers the opportunity to add other skills they thought important which were not included in the question. Other technical skills companies believed to be more important than those previously mentioned included:

--- bio-chemical calculations and operation of HPL
--- being able to evaluate and label material
--- additional chemistry skills (analytical, physical and organic)
--- get along with people

Employee Benefits

Compensation

Data from the employer surveys indicated that the average starting salary for an entry-level biotechnician ranged from $15,000 to $25,000 per year. One company reported earnings of $8 per hour for their biotechnicians, while another organization was not sure because their headquarters hires the biotechnicians, so the respondent was not privy to this information.

It is difficult to compare salaries offered by different companies, because job duties and job titles are not uniform within the industry. Another limitation is that most of the literature does not specifically address biotechnicians under the rubric of biotechnology. So it is difficult to compare national data to that of our employer survey. For example, the median salary for technicians in southern California was $36,478, whereas the San Francisco Bay study reported that entry level technicians with no prior experience averaged $22,000 per year (Resource, 1995).

Employer Provided Benefits

All but one employer provided information on their employees package. The remainder of the employers provided either adequate, standard or generous benefit packages. Adequate plans included health and life insurance plus vacation time. A generous plan consisted of full health and dental, three weeks vacation, tuition reimbursement and a generous holiday and vacation package.

Advancement Opportunities

Based on the review of the literature and employer narratives, there seemed to be little opportunity for the advancement of biotechnicians, especially those with two-year degrees. Most research has established that employers are looking for employees who have at least a bachelor's but preferably a master's (See Table 10) in biology or chemistry (Brown, 1994; Employer Survey, 1996). Many of the reasons given for the limited opportunity for advancement is that individuals with a four-year degree in biology and chemistry are currently occupying these occupations. In instances where there might be chances to advance, employees with bachelor's degrees will be promoted before those with associate degrees.

Professional Access & Educational Qualifications

Most of the published literature used in this study suggests that a bachelor's degree is needed to gain access into the profession. Industry appears skeptical toward two-year programs in biotechnology. Many of the employers were concerned whether two years colleges can provide the knowledge necessary to manage complex instrumentation and whether without a theoretical understanding, students would be able to adapt to the changing needs of technology (Brown, 1994).

Based on our employer surveys, we assessed what the *minimum* and *preferred* educational credentials would be for biotechnicians in the industry (See Tables 9 and 10).

Table 9 **Minimum** Educational Qualifications Needed by Biotechnicians

Degree	*Number*
No specific degree requirements	0
High school diploma or GED	0
Associate degree (biotechnology)	5
Bachelor's degree:	4
*Biology	
*Science	
*Chemistry	
*Combined: Chemistry & Biology	
Other	0

*Majors suggested by employers
Source: Employer Survey, 1996 n=9

In addition, we asked employers to provide us with their preferred educational credentials, given their assessment of the industry and their own employment needs. Employer responses to this question are listed in Table 10.

Table 10 **Preferred** Educational Qualifications Wanted by Employers

Degree	*Number*
No specific degree requirements	0
High school diploma or GED	0
Associate degree (biotechnology)	0
Bachelor's degree:	7
*Biology	
*Chemistry	
*Combined: Chemistry & Biology	
Master's	1
*Biology or Chemistry	
Other	0
Missing	1

*Majors suggested by employers
Source: Employer's Survey, 1996 n=8

To further assess the issue of educational qualifications, we asked whether a company would hire or would consider hiring a biotechnician with an associate degree from a community college (See Table 11).

Table 11 Company's Employment Consideration of a Biotechnician with an Associate Degree from a Community College

Answer	*Number of Employers*
Yes	9
No	0
Uncertain	0

Source: Employer Survey, 1996 n=9

Although employers would prefer to employ biotechnicians with a minimum of a bachelor's degree, they would entertain the thought of hiring an individual with an associate degree.

Training

Companies do use training to augment the skills and knowledge of their employees. Some companies use their own in-house training whereas others contract with outside organizations and agencies (Resource, 1995). In the Southern California study, among those firms that offered training to their technicians, nearly two-thirds provided in-house training, while eleven percent went with outside private vendors. In addition, nine percent used colleges/universities for training employees and the other fourteen percent were classified as "other."

In our survey of the region's employers, all nine indicated that they provided company sponsored training for their biotechnicians. Where the training occurred is listed in Table 12. *Note: employers were asked to check all that applied.*

Table 12 Training Sources Utilized by Companies for Biotechnicians

Source of training	*Number*	*Percentage*
In-house	8	42
Outside consultant/vendor	5	26
College/tech school	1	5
Other	5	26
Total.....	19	100%

Source: Employer survey, 1996 n=9

In-house training was also the most used resource in our survey. The other principal sources of training included outside consultants or vendors (26%) and the "other" category (26%). College and tech schools were only utilized five percent of the time for additional instruction.

Internships

We also attempted to evaluate whether the employer thought that a biotechnology internship would be beneficial to the student as well as the employer (See Table 13).

Table 13 Benefits of an Internship to the Student and Employer

Student Benefits		*Employer Benefits*	
Response	Number	Response	Number
Yes	7	Yes	5
No	0	No	1
Uncertain	1	Uncertain	1
Missing	1	Missing	2

Source: Employer survey, 1996 *n=9*

Whereas the majority of the employers believed an internship would be beneficial for the individual student, employers were not in total agreement on whether an internship would be beneficial for their company. Of those companies which did believe that the concept of an internship would be advantageous for the student (n=7), we also asked what the "ideal" time period should be for an internship. Of those who answered, two companies stated that it should be a full-time commitment of three months; two other firms suggested a minimum of one year; and the other three were not certain.

Since seven companies thought it would be beneficial to the student and five thought it would be helpful to the company, we asked if these organizations would consider providing an internship possibility for an OCC student in biotechnology. Four of the respondents stated they would be interested in providing an internship opportunity; one stated they would not; and four responses were missing. (For a listing of companies who would provided an internship, please see Appendix A).

When asked if their company would be interested in working with OCC in developing a biotechnology program, six employers stated they would be interested, two suggested they would not be interested and there was one employer who did not answer the question. (See Appendix A for listing).

Biotechnology Programs in Michigan

Our research located two other institutions of higher education in Michigan offering specific programs in biotechnology. Ferris State University, in Big Rapids, offers a bachelor's of science in biotechnology which is designed to prepare students for positions in biological, medical or agricultural research. Their program is based on four aspects of laboratory expertise: recombinant DNA, tissue culture, immunology and advanced isolation techniques (FSU Catalog, 1995-1997).

The first two years of the program are preparatory in which students complete the biotechnology foundations course work. Beginning at their junior year, students would begin the professional sequence of course work.

Foundation classes (first two years) consist of courses in biology, chemistry, math and physics, each at the 100 or 200 level. The professional sequence consists of the same classes, only at the 300 and 400 level in addition to either an internship in biotechnology or an independent study in biology. Transfer students must have a 2.0 GPA and a "C" or better grade in math prep to enter the program.

Delta College in University Center, Michigan does have pre-biotechnology program. However, according to Yolonda Douglas in academic advising, the program is for students who desire to transfer to an institution with a four-year biotechnology program. Students concetrate their studies on chemistry or biology to prepare for transfer. The pre-biotechnology program was established for transfer purposes only; it was not designed for students to enter into the workforce after completion.

Biotechnology Programs Outside of Michigan

Nationally, there are a limited number of community colleges offering a two-year degree in biotechnology. Brown (1994) indicates that there are only five community colleges (Becker Jr. College, MA; Central Community College, NE; Monroe Community College, NY; Technical College of Alamance, NC; Madison Area Technical College, WI) which offer a degree in biotechnology. However, there has been at least one other institution added to the list since the publication of Brown's book. Seattle Community College has also begun a program in biotechnology with the assistance of corporations in their local geographic region.

I contacted Virginia Naumann from St. Louis Community College to ascertain if their organization had a biotech program or was in the process of designing a major in biotechnology. I obtained her name from an e-mail list of faculty who attended a conference last summer on biotechnology in the community college. Ms. Naumann stated that although St. Louis Community College does not have a two-year biotech program, they have gone through a modified DACUM process to assess the needs of the local community. She stated that their findings suggested that the companies in the area would only hire graduates with a four-year

degree and would not consider hiring anyone with a two-year certificate. She also stated that in their research, they had found that those companies which were likely to hire a two-year biotechnicians were very small companies specializing in biotechnology. However, these small companies did not seem to be located in their region. St. Louis Community College has decided to delay their two-year program until the biotechnology industry expands in their service region. Ms. Naumann did state that they are continuing to develop classes in biotechnology techniques to help re-train those who are already in the industry and to help high school teachers develop methods that they might not have received in their college teacher training programs.

Information was also requested on the biotechnology program at Central Community College in Hastings, Nebraska. However, no one responded to our request for material on their biotechnology program.

DISCUSSION

Although the field of biotechnology is emerging as a growing and fast-paced industry, it seems to be geographically specific. Most of the biotechnology firms are located on the east and west coasts with relatively few in the Midwest or South. The growth of firms who would employ biotechnicians seems quite limited in southeastern Michigan. This was evident in our attempt to construct a list of companies who employed biotechnicians. To assemble such a index, which would encompass enough companies which hired biotechnicians, we included additional metropolitan areas beyond our targeted region. After contacting 269 companies, we located only nine companies which employed biotechnicians.

The limited number of companies employing biotechnicians is one obstacle to the creation of a biotechnology curriculum. Among those companies who employed biotechnicans, we assessed their future employment needs. Only one firm planned to hire six to ten biotechnicians over the next three to five years, whereas five employers stated they would hire one to five biotechnicians over the same time period. From the data, is seems that there would not be an abundance of biotechnician jobs for graduates from a program at OCC. From our conversations with employers, there does not seem to be a need to hire biotechnicians at this point in time or in the near future.

Data from our employer surveys indicated that human diagnostic substances seemed to be the largest market segment that companies identified with in their industry. This was followed closely by employers who indicated they were also in the chemical, biological and agricultural industrial segments. The majority of companies also listed their industrial setting as a research laboratory which was closely followed by a university, governmental or nonprofit research organization. These findings may prove useful when designing the curriculum and internship or job placement programs for students in a biotechnology program.

The most salient issue from the survey seems to be the educational requirements for employment in the industry. Our findings indicated that employers would consider hiring an individual with an associate degree. However, approximately the same number of employers wanted a student with a minimum of a bachelor's degree. Employers seemed to be searching for biotechnicians with a four-year degree in either biology, chemistry or a combination of the two. One could interpret that even though employers would hire someone with an associate degree they would prefer to hire a biotechnician with the minimum of a bachelor's degree. The employer survey data seemed to validate other research which suggested that a bachelor's degree is needed to enter the field of biotechnology, even for a biotechnician. This finding was also significant in elucidating the biases of employers on educational qualifications of community college students. This was exemplified in companies who would consider hiring a biotechnician with an associate degree but prefer to employ someone with a four-year degree.

Competencies needed to work in the field were assessed in both the general and technical areas. Basic math and decision-making were the two most frequently cited skills in general competencies for biotechnicians. Conversely, organizational skills, prioritizing tasks and knowledge of safety and regulations were listed lower on the continuum. These findings either suggest that employers were satisfied with mathematical and decision-making abilities of their employees or they believed that the skills were not essential for job performance. Employers also suggested employees should receive further training or knowledge content in areas of organizational skills, prioritizing tasks and knowing safety and rule policies and procedures.

Those employers responding to our survey seemed more interested in having employees who could follow complex protocols and were able to troubleshoot and maintain accurate records and/or logs. These three concerns not only were the most frequently mentioned areas but they also significantly outnumbered specific biotechnology competencies (i.e., plasmid purification and RNA experiments). This may suggest that employers are searching for employees in the field who can traverse between complex non-specific and industry specific competencies and skills.

Companies also believed that internships were an important instrument in students' gaining knowledge and skills in biotechnology. More employers thought that the concept of the internship was more important for students than it was for employers. This may be an important issue when designing the curriculum for biotechnology. If OCC does design and implement a biotechnology program, six of the nine firms stated they would be willing to assist Oakland Community College in their endeavor.

LIMITATIONS

One of the limitations of this report was the number of employers we were able to survey for this project. With only nine participants, the ability to generalize to companies who employ biotechnicians is severely limited. Some of the data may be suspect (e.g., salary) because of the small number of companies which responded to our survey. A larger sample would improve external validity and multiple measures of indicators would enhance reliability.

An additional limitation in our data collection efforts was the length of the survey. A few employers refused or declined to answer certain questions because of their length and the time required to respond to certain inquiries. Although most employers did answer the majority of the questions, some respondents thought the instrument was too long and thus refused to provide responses.

CONCLUSION

Biotechnology is rapidly becoming a leading industry and employer in certain regions of the United States. However, industry growth does not seem to be developing in southeast Michigan. The issue of non-growth in this sector has significant implications for the establishment of a biotechnology program at Oakland Community College. If there are not enough companies to employ biotechnicians and the industry presently does not seem to have a need for this type of employee, then is there a valid justification for the program?

Employers also seemed more interested in employing students who have obtained a bachelor's degree, preferably in the sciences, rather than someone with an associate degree. Although there are arguments on the cognitive intellect of two-year college students, employers' perceptions are such that they would prefer to hire someone with a four-year degree in the physical sciences.

The assessment of the biotechnology industry suggests that it may be premature to establish a biotechnology program at OCC at the present time. Although the national literature predicts the need for more employees in the field, it is still too early to determine when or how the associate degree will be considered a valid assessment of an individual's readiness, especially in a field dominated by doctorates, master's and bachelor's degrees. In conclusion, it may be practical to follow the lead of St. Louis Community College and delay the implementation of such a program until the biotechnology industry expands in the southeast Michigan.

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APPENDIX A

Employer List

Employers Surveyed
November 1996

Company Name	Address	Person Contacted	Telephone Number & e-mail	Provide Internship	Willing to Assist OCC
1. Anatrace, Inc.	Maumee, OH	Mel Keyes	419-891-3030 anatrac434@aol.com		Yes
2. Growth Resources	21666 Melrose Southfield, MI	Tom Brown	810-350-0337		No
3. Ecolab	St. Paul, MN	Susan Christianson	612-293-2238		No
4. Michigan Clone Associates, Inc.	Troy, MI	Dr. Howard Toben	810-538-1150	Yes	Yes
5. Central Golden Harvest	Dansville, MI	Dr. Grant Metz	517-623-0122	Yes	Yes
6. Michigan State University	East Lansing, MI	Joe Leykew	517-355-4755	Yes	Yes
7. University of Michigan	Ann Arbor, MI	Curt Smilka	313-747-0253	No	Yes
8. Assay Designs, Inc.	Ann Arbor, MI	Barb Schauer	313-668-6113 assaydes@pipeline.com	Yes	Yes
9. Pioneer Hi-Bred International	Ithaca, MI	Randy Laurenz	517-875-2220 laurenRG@THI.com		

APPENDIX B

EMPLOYER SURVEY

OAKLAND COMMUNITY COLLEGE

Biotechnology
Needs Assessment
Employer Survey

(Verify employer information at the end of survey)

Name: _____

Title: _____

Name of Business: _____

City and Zip Code: _____

Telephone: ( ) _____ -- _____

E-Mail address: _____

I am calling on behalf of Oakland Community College. We are in the process of assessing current trends in biotechnology and employment opportunities for biotechnicians in southeast Michigan. Do you have a moment to answer a few questions for us? *(If no, terminate survey)*

1. Can I first confirm that you employ biotechnicians in your organization?

   1_____Yes

   2_____No **(thank them for their time, terminate survey)**

To help facilitate the process, we have defined a biotechnician as an individual with the skills and knowledge required to work at the introductory level of biotechnology. Is this similar to your organizations's definition of a biotechnician? **(If yes, continue survey--if not, please have the interviewee define their organization's definition of a biotechnician below and continue survey)**

_____

_____

_____

2. First, we would like to know about the type of work your organization is involved in. How would you describe the industry in which your company performs ? *(Allow employer to give you an answer. If it is not listed below, put in the "other" category. If you're not sure where it belongs, please ask the interviewee. Circle all that apply)*

	YES	NO
Agricultural	1	0
Biological Products	1	0
Human Diagnostic Substances (e.g., diagnostic kit components)	1	0
Pharmaceutical Products	1	0
Chemical	1	0
Food & Food Additives	1	0
Therapeutic methods and products	1	0
Supplier	1	0
Environmental (bioremediation)	1	0
Other (please explain)_____	1	0

3. Which of the following industrial settings would best describe your organization?
(Allow the employer to give you an answer. If it is not listed below, put in the "other" category. If you're not sure where it belongs, please ask the interviewee. Circle all that apply)

	YES	NO
Research laboratory	1	0
Biotechnology Laboratory	1	0
University, governmental or other non-profit research organization	1	0
Pharmaceutical company	1	0
Other (please explain)_____	1	0

4. Can you tell me how many people your company employees?

	YES	NO
Small (1-50 employees)	1	0
Medium (51-135 employees)	1	0
Large (136-299 employees)	1	0
Top Tier (300 + employees)	1	0

5(a). On average, how many hours per week do your full-time biotechnicians work?
_____*(fill in number)*

5(b). On average, how many hours per week do your part-time biotechnicians work?
_____*(fill in number)*

6. We would like to know which skills and competencies are important when hiring new employees in the biotechnology area. Could you please tell me whether the following *technical* skills are **very important, somewhat important**, or **not important**.

	VI	SI	NI	No response
Protein/Enzyme Competencies *(Don't ask)*				
Isolate, identify and label proteins	3	2	1	9
Protein determination	3	2	1	9
DNA/RNA Competencies *(Don't ask)*		*(Repeat scale)*		
Sequencing	3	2	1	9
Isolate, identify and label nucleic acids	3	2	1	9
Sizing of DNA	3	2	1	9
Mapping of DNA	3	2	1	9
Quantification of DNA	3	2	1	9
Plasmid Purification	3	2	1	9
	(Repeat scale)			
Restriction digests/Plasmid digestion	3	2	1	9
Hybridization	3	2	1	9
RNA experiments	3	2	1	9
Basic cloning techniques	3	2	1	9
DNA/RNA amplification (e.g. PCR)	3	2	1	9
Additional technical competencies *(Don't ask)*		*(Repeat scale)*		
Blotting	3	2	1	9
ELISA	3	2	1	9
Cell/Tissue culturing	3	2	1	9
Standard microbiological techniques	3	2	1	9
Immunological techniques	3	2	1	9
Assays	3	2	1	9
Other competencies *(Don't ask)*		*(Repeat scale)*		
Inventory and Supply Maintenance	3	2	1	9
Following complex protocols	3	2	1	9
Troubleshooting ability	3	2	1	9
Maintaining accurate records/logs	3	2	1	9

7. Are there other skills you would consider important?

_____

_____

8. I'm now going to go through a list of general skill areas, please tell me whether newly hired biotechnicians are adequately or inadequately trained in the following areas?

	Inadequate	Adequate	No Response
Basic Math (Fractions, percentages, etc.)	1	2	9
Communication (Electronic, oral, written)	1	2	9
Critical thinking	1	2	9
Decision-making	1	2	9
Organization skills	1	2	9
Prioritizing tasks	1	2	9
Computer literacy	1	2	9
Knowledge of safety and regulations	1	2	9
Problem solving	1	2	9
Teamwork	1	2	9
Responsibility/integrity/honesty	1	2	9
Work ethic	1	2	9

Now, I would like to learn more about the educational qualifications for employment in your organization.

9(a). Please tell me what your organization's **minimum** educational qualifications are for entry-level biotechnicians: *(Only prompt by reading the list if necessary)* **Check only one**

1____No specific requirements
2____High school diploma or GED
3____College associate degree (Biotechnology program)
4____Bachelor's degree (program/major: _____)
5____Other _____

9(b). What are your organization's **preferred** educational qualifications for entry-level biotechnicians? **Check only one**

1____No specific requirements
2____High school diploma or GED
3____College associate degree (Biotechnology program)
4____Bachelor's degree (program/major: _____)
5____Other _____

10. What is the minimum amount of work experience required for entry-level biotechnicians?

_____

_____

11. Would your organization hire or consider hiring a biotechnician with an associates degree from a community college?

1_____Yes *(continue with question 12)*
2_____No *(go to 11a)*
7_____Uncertain *(go to 11a)*

11(a) Could you explain your reasoning?

_____

_____

_____

12. Does your organization provide biotechnicians with any company- sponsored training?

1 Yes (continue with question 13)
0 No (skip to question 14)

13. Where does the company-sponsored training occur? *(read choices; select all that apply)*

	YES	NO
In-house	1	0
Outside consultant/vendor	1	0
College/tech school	1	0
Other _____	1	0

Now I'd like to ask you about employment opportunities and hiring practices in your organization.

14. Do you **never, sometimes**, or **frequently** have any difficulty finding qualified biotechnicians?

*1*____Never
*2*____Sometimes
*3*____Frequently
9____No response

15. In your opinion, how many new biotechnicians do you expect to hire over the next 3-5 years? *(read list first,)*

	YES	NO	
1-5 biotechnicians	1	0	
6-10 biotechnicians	1	0	
11-15 biotechnicians	1	0	
16-20 biotechnicians	1	0	
20+ biotechnicians	1	0	
None	1	0	
Don't know/Uncertain			7

16. In terms of salary, what is the average annual starting salary for an entry-level biotechnician position in your organization? **$_____ (note whether this is hourly, weekly, monthly, or annually--also note whether it is part-time or full-time)**

17. What are the typical benefits made available to your biotechnicians? *(e.g.,health insurance, paid vacation, sick leave, etc.)*

_____

_____

18. Do you feel that a two-year college level Biotechnology program is needed in southeast Michigan?

1	Yes (continue with question 19)
0	No ***(go to Question 20 then terminate survey)***
7	Uncertain ***(go to Question 20 then terminate survey)***

19. Do you believe that a biotechnology program should be developed at OCC?

1	Yes (go to question 20)
0	No ***(go to Question 20 then terminate survey)***
7	Uncertain ***(go to Question 20 then terminate survey)***

20. Can you explain your response? *(probe)*

_____

_____

21(a). Do you believe an internship in biotechnology would be beneficial for the college student?

*1*_____Yes
*0*_____No *(go to question 24)*
*7*_____Uncertain *(go to question 24)*

21(b). Do you believe an internship in biotechnology would be beneficial for the sponsoring company or organization?

*1*_____Yes
*0*_____No *(go to question 24)*
*7*_____Uncertain *(go to question 24)*

22. How many months/weeks do you believe an ideal biotechnician internship should last?

_____

_____

23. Do you think that your company/organization would consider providing an internship opportunity for an OCC student?

*1*_____Yes
*0*_____No
*7*_____Uncertain

*Comments:*_____

_____

24. Would you be interested in working with OCC to develop a biotechnology program?

1 Yes *(add to the help list)*
0 No
7 Uncertain

25. Are there any other comments or suggestions you would like to include concerning the proposed Biotechnology program at OCC?

_____

_____

_____

_____

Thank you for your time and assistance. We appreciate your help and believe that your responses will help to influence what happens at OCC in the future. If you have any further questions, please contact the Office of Planning & Analysis at 810-471-7746.

Interviewer Signature: _____ Date: _____

APPENDIX C

EMPLOYER NARRATIVES

Employer Survey Narratives

NOTE: Numbers preceding employer responses correspond with company number in Appendix A.

1a. How would you define a "biotechnician" if different from OCC's definition?

1. They make reagents for the biotechnology area.
4. Need chemistry background; ability to put together certain buffers from basic chemicals in a jar; knowledge of tissue culture, animal husbandry, handling small animals.
5. Someone involved in working in the implementation of the genetic materials of plants or animals.
7. Need a pre-med background.
8. Should have a bachelor's degree.

10. What is the minimum amount of work experience required for entry-level biotechnicians?

1. None--it would be good if they had maybe a summer job but we hire people right out of college.
2. Graduation from a four-year program (B.S.).
3. 0-1 years.
4. No work experience is required if I could find someone with the necessary degrees. I would train them myself.
5. Nothing.
7. One-year with diagnostic competency.
8. None--take them right out of college.
9. Depends on education--a lot then no work experience is needed. Without an education a lot of lab experience is required--the more the better.

11a). Would your organization hire or consider hiring a biotechnician with an associate degree from a community college? If no or uncertain, could you explain your reasoning?

1. Have to look very carefully at courses they've taken. Background in chemistry is very important.
4. Yes, but this doesn't sound like an OCC student to me. Usually have somebody with a bachelor's or master's. Don't think someone with a two year degree would have enough education.
8. The expense difference. If someone with a two-year degree has adequate training and their courses target what's important, we'd hire them.

18. Do you feel that a two-year college level biotechnology program is needed in southeast Michigan? If no or uncertain, can you explain your reasoning?

    1. Depends on the coursework of the program. Would like someone with a two-year degree, however.
    2. Wouldn't know if one is needed.
    3. Doesn't know the southeast Michigan area--they probably wouldn't hire anyone from this area.
    7. Can't speak for other schools.
    9. This isn't a concern of ours. We have about 3,000 employees in North America. To others having a biotechnology program in southeast Michigan may be important.

19. Do you believe that a biotechnology program should be developed at OCC?

    4. This is an area that we need good people. If people don't have a bachelor's or master's degree but an associate, they could be trained more easily if they at least had some type of background in tissue culture.
    5. Not familiar with school so I don't know how to respond.
    6. Unfamiliar with school.
    8. Should be a program someplace so why not OCC?

22. How many months/weeks do you believe an ideal biotechnician internship should last?

    4. Depends on what area. Should be at least three months for protein isolation and tissue culture. This would be 40 hours per week.
    5. 9-12 weeks.
    6. At least one year, preferably two years.
    7. One year.
    8. Three months at 40 hours per week.

23. Do you think that your company/organization would consider providing an internship opportunity for an OCC student? ---*Comments*----

    4. Not doing anything in that area now but maybe sometime in the future.
    5. Do have one [an intern] now.
    7. We have our own students to choose from.
    8. The two founders of the company really support internships. Presently have one from Ferris State.

25. Are there any other comments or suggestions you would like to include concerning the proposed biotechnology program at OCC?

1. Students should have some math background. We've found that biology majors are lacking in that area.
   Additional comments not specifically related to #25:
   Throughout the interveiw, Mr. Keyes expressed great interest in a biotech program and would really like to talk to Mr. Bidol. When they were part of Owens-Illinois, their department was mostly research and they had biology majors working there. Now a lot of the work is production and it doesn't require a four-year degree. Mr. Keyes hires a lot of people through a temporary agency. He had an assistant go to Bowling Green State University and University of Toledo to try and recruit somebody to work for Anatrace during their senior year---no takers.
4. Should talk with someone in the DNA area and get more input from them.
5. Would be willing to give advice or talk with someone regarding biotechnology.
6. You can contact: Dr. Wyan Lewis, MSU, 517-432-5097 or 21394wml@msu.edu for further information.
8. There are lots of things I'd like to discuss.