Findings from the NSF ATE Biosciences Industrial Fellowship Program Year 4 Fellows Survey

NSF ATE DUE # 1304010

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EXECUTIVE SUMMARY

The Bioscience Industrial Fellowship Project (BIFP), funded by a National Science Foundation Advanced Technology Education (ATE) grant (NSF ATE DUE # 1304010), provides community college instructors and K-12 teachers from across the nation a broad view of the bioscience industry in North Carolina. The goals of this project are to:

1. Equip Fellows with industry-oriented contextual bioscience experiences;
2. Help Fellows make connections with their students such that they understand the real-world relevance of STEM coursework;
3. Help Fellows understand career opportunities in the biosciences such that they can inspire career interest in life sciences among their students; and
4. Develop leadership qualities among the fellows to aid them in effectively disseminating their bioscience industry experiences with others.

In June 2017, 11 Fellows spent over three weeks traveling throughout North Carolina to gain hands-on skills and practice in lab techniques utilized in biotechnology and to learn about the areas of research and industry related to or resulting from biotechnology. At the end of their fellowship, Fellows develop presentations that they will share with colleagues at their home institutions (whether community colleges, K-12 school or, etc.) to promote involvement in the biosciences. Within two weeks after Fellows had returned home they completed a web survey about their experiences and its impacts.

Survey responses indicate that fellows found their time in North Carolina very informative, professionally powerful, and enriching. Fellows reported that the BIFP helped them better understand biotechnology, including:

- the range of industry occurring in North Carolina;
- job opportunities in biotechnology; and
- the skill sets needed by those interested in the field.

Fellows reported that their fellowship experiences will translate into them sharing with others about opportunities in the biotechnology field, the skills needed to be employed in this field, and the opportunity to participate in the BIFP.

Much of the success if this fellowship lies in the training provided to Fellows and the site visits in which Fellows participated.

- Training opportunities provided very useful hands-on experiences and introduced them to labs and lab techniques that they will share with their students.
- Site visits helped Fellows understand the diversity of jobs in the biotechnology field, enabling them to make useful contacts with those in the field and learn about what skills, including the lab techniques that they practiced, were needed by those interested in being employed in this field.
- Guest speakers presented on topics that Fellows found interesting and about which they had little knowledge.

Although some Fellows struggled with understanding expectations and wanted concrete objectives related to their presentations, most indicated that they had the resources they needed to develop them. Despite this, all appeared pleased with their presentations and noted how useful their development was in helping them summarize what they had learned and identify critical things to share with colleagues or students.

Based on the above findings, there are few recommendations for the BIFP. Most importantly, the program should continue to provide support around the development of presentations, including providing time for Fellows to develop them.

OVERVIEW

The National Science Foundation funds the Bioscience Industrial Fellowship Project (BIFP) through the Advanced Technological Education Program DUE Grant (NSF ATE DUE # 1304010). This project is based at Forsyth Technical Community College in Winston-Salem, NC in collaboration with Rowan-Cabarrus Community College in Kannapolis, NC and Alamance Community College in Graham, NC. Partners in this project include, among others, the Wake Forest Institute for Regenerative Medicine (WFIRM), Bio-manufacturing Research Institute and Technology Enterprise (BRITE) at North Carolina Central University, the BioNetwork's Pharmaceutical and Analytical Training Lab and Capstone Center, The Joint School of Nanoscience and Nanotechnology at UNCG, the David H. Murdock Research Institute, and Commercialization at Wake Forest Innovation.

For this project, up to 12 Fellows from across the nation gain a broad view of the bioscience industry in North Carolina. Fellows participate in boot camps at community colleges with hands-on lab experiences and shadow workers in various departments at multiple industrial/university hosting facilities.

The goals of this project are to:

- Equip Fellows with industry-oriented contextual bioscience experiences;
- Help Fellows make connections with their students such that they understand the real-world relevance of STEM coursework;
- Help Fellows understand career opportunities in the biosciences such that they can inspire career interest in life sciences among their students; and
- Develop leadership qualities among the fellows to aid them in effectively disseminating their bioscience industry experiences with others.

In June 2017, 11 Fellows spent over three weeks traveling throughout North Carolina to gain hands-on skills and practice in lab techniques utilized in biotechnology and learn about areas of research and industry related to or resulting from biotechnology. At the end of their time in North Carolina, Fellows worked in pairs to develop presentations that they will share with colleagues at their home institutions (whether community colleges, K-12 school, etc.) to promote involvement in the biosciences. Within two weeks after Fellows had returned home, ten of the eleven completed a web survey about their experiences and its impacts. The following section presents findings from this survey.

FINDINGS

Guest Speakers

Fellows had the opportunity to hear from four guest speakers about the biosciences industry in NC and beyond. As part of the survey, they rated how useful they found hearing from the

following guest speakers on a scale of 1 (Not useful at all) to 5 (Very useful). Dr. Daniel Herr and Bob Rehfuss were the speakers that most resonated with the Fellows.

Guest Speakers

Daniel Herr and Bob Rehfuss were the highest rated guest speakers

When asked what they liked about the speakers, comments included the breadth of their experience, how captivating some talks were, and seeing how excited speakers were about their topics. Additional comments are included below.

> "The fact that their expertise greatly informed me in a captivating way about nanotechnology and drug discovery, areas I really had no knowledge of prior to this. And even though patent applications are far removed from what I do, Dr. Batalia's presentation was quite eye-opening; he's obviously extremely knowledgeable."

> "The presentations were well designed for a diverse audience like us. I was new to the field and the presentations were clear to me. The speakers were very knowledgeable in their fields and shared it well."

> "I learned so much that I did not know about the industry, in particular from Daniel Herr, that I can take back to my biotechnology programs at my college."

Suggestions for improving guest speakers included:

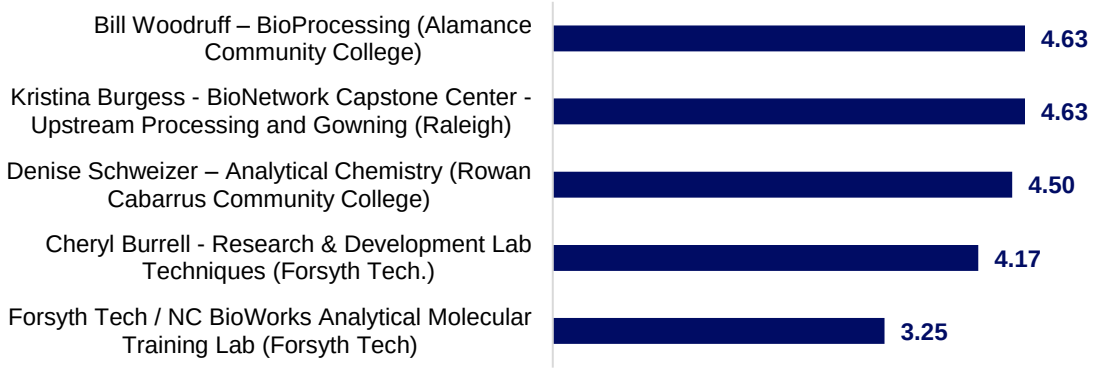
- Reconsider a different guest speaker for the last day, after presentations; and
- Have speakers try to incorporate hands-on, industry related activities into their talks.

Lab Training

The survey provided Fellows an opportunity to rate the usefulness of the lab training in which they participated. Shown below are Fellows' ratings on a scale of 1 (Not useful at all) to 5 (Very useful) with respect to how useful they found the various training opportunities. As can be seen, Fellows rated the training they received from Bill Woodruff and Kristina Burgess the highest.

Lab Training

Fellows rated training provided by Bill Woodruff in bioprocessing and Kristina Burgess in upstream processing and gowning highest.



Fellows noted that they most liked the fact that the trainings provided hands-on opportunities, that they learned new lab techniques, and that they could use these labs with their own students. Other comments are shown below.

> "All excellent. FT/NCBW lab was impressive, but time there was too short, especially once we got to the computer lab."
>
> "The hands-on components, actually making a product step by step, was very rewarding."
>
> "Introduction to several lab activities I had no previous experience with - gas chromatography and bioinformatics."
>
> "The SOP's were clear and the instructors were engaging and very helpful."
>
> "Loved the hands-on experience. I especially loved the training with Bill Woodruff and the cell culturing."

Suggestions for improving lab trainings were to ensure that enough time is available for all labs and to include some higher-level labs/fewer entry-level labs. Other comments were:

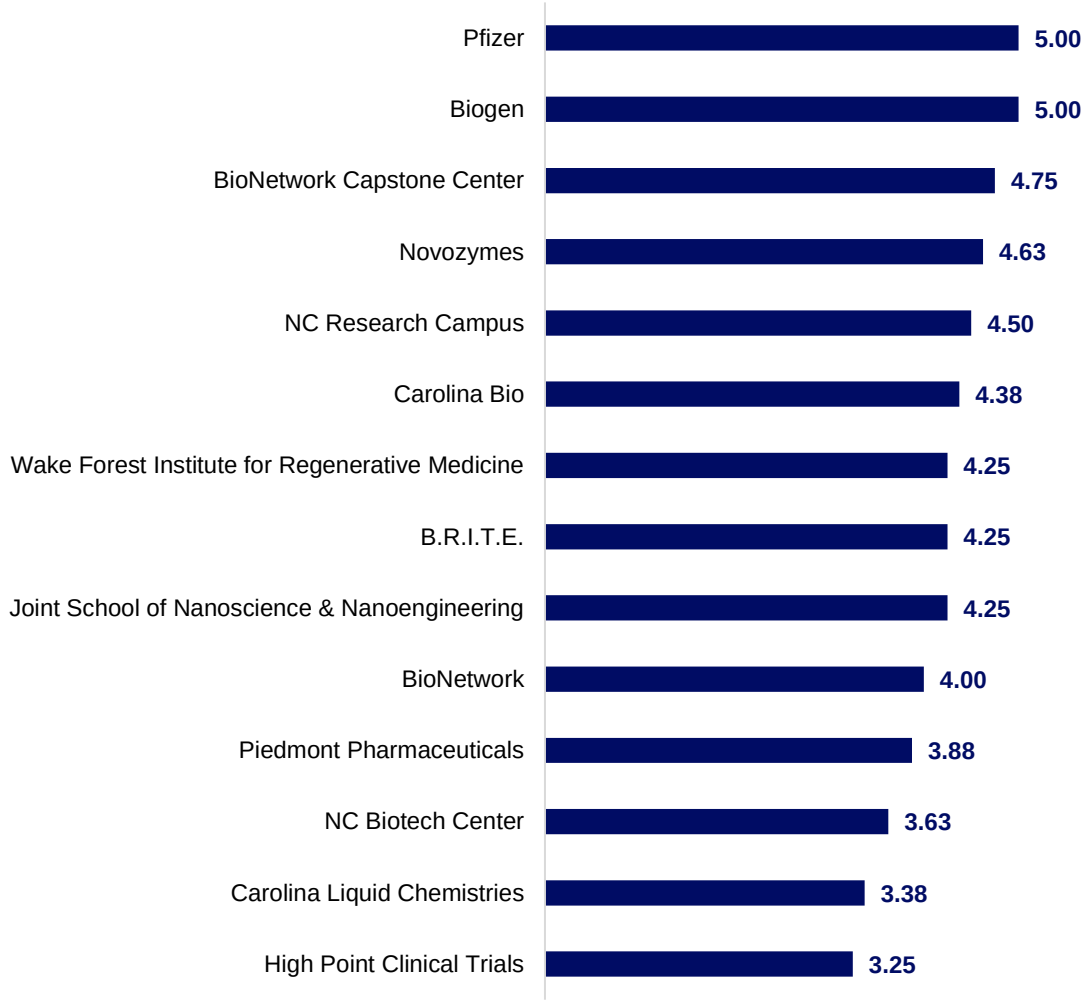
- The Forsyth Tech was good, but a bit redundant. It was still a good exercise.
- The Forsyth experience was done on old material that validated (in the instructor mind) that it wasn't going to work. The bioinformatics portion was not downloaded on the class computers in a timely manner, and had to be done in Linux; few of us understood what we were even trying to achieve let alone understood the results we received.
- Most of these trainings were well-planned but the analytical molecular trading was the least successful. It seemed haphazard and it was less about our doing something and more about watching him to things. Plus, he wasn't always clear on his instructions. The techniques were interesting but it felt like a waste of time.

Site Visits

Fellows rated the usefulness of the site visits in which they participated, again on a scale of 1 (Not useful at all) to 5 (Very useful). Fellows rated the site visits to Pfizer, Biogen, the BioNetwork Capstone Center, and Novozymes as most useful.

Site Visits

Fellows rated visits to Pfizer and Biogen highest.



Fellows noted that site visits provided a good opportunity to see the wide range of biotechnology applications, helped them understand unique applications of biotechnology, and reinforced what they had learned participating in the labs. Other comments were:

> "Everything we were learning about in the bootcamps were made real during the tours. It was good seeing real world applications and corporate cultures."

> "The visits reinforced the procedures which helped my put everything together. "Since I had minimal knowledge on this industry, the visits on these sites

complemented the labs we completed. Also, the sites showed us how they operate and what technical, academic, and soft skills the jobs required. All the sites were willing to share everything with us, and teach us processes as well."

"While many of them did similar things, they each had a unique perspective and company culture. It was good to see different aspects of industry."

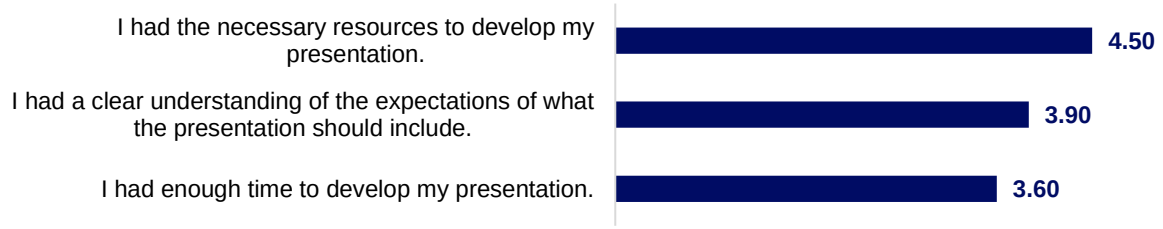
Suggestions for improving site visits included slightly reducing the number of sites visited.

Presentations

Fellows rated how true positively worded statements about their development of their presentations were, using a scale of 1 (Not true at all) to 5 (Very true). Ratings indicate that Fellows believed that they had the resources they needed to develop their presentations, but were less positive as it related to time to develop them and their understanding of expectations related to them.

Presentations

Fellows rated most true that they had the necessary resources to develop their presentations.



When asked what they gained by developing their presentations, Fellows responded by saying that this experience gave them a "better understanding and appreciation of bioscience" and helped them see "that biotechnology spans a number of career fields, and can easily be incorporated in some way in most college courses". Some Fellows also indicated that it was a good way to reflect upon their experiences. Additional comments are shown below.

"I don't believe that I developed a learning module. I believe that we were tasked with developing a presentation that captured our experiences, and ways to share those experience with our students and colleagues."

"I was able to organize the wide array of experiences into a coherent presentation that I will use in the future."

"I gained knowledge on the type of mathematical skills these modules required."

"I learned that terminology and knowledge on the topic are very important in achieving success in the procedures, and that as a teacher I must be very careful when designing an activity for my students."

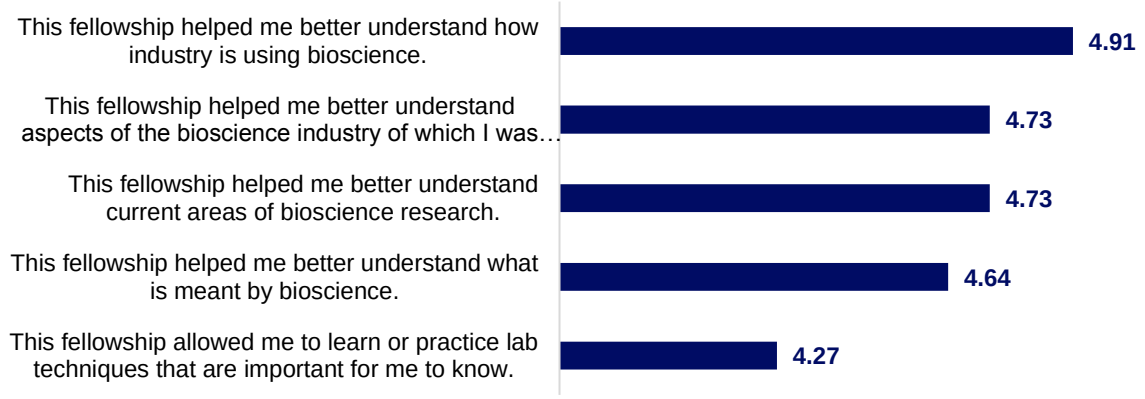
Suggestions for better supporting the development of presentations included providing clearer expectations earlier on and in writing and providing more time to for their development.

Overall Impacts

Fellows rated how true positively worded statements describing potential impacts of their fellowship were for them on a scale of 1 (Not true at all) to 5 (Very true). As is shown, Fellows indicated that the fellowship helped them better understand what is meant by bioscience, current areas of bioscience research, how industry is using bioscience, and aspects of the bioscience industry of which they were unaware. Fellows' responses were mixed, although still quite high, as it related to their learning or practicing lab techniques.

Overall Impacts

Fellows rated most true that the BIFP helped them understand how industry uses bioscience and learn about aspects of the bioscience industry of which they were not aware.



Fellows rated their experiences as very strong (mean = 4.25, sd = 0.71) in terms of its impact on them professionally, on a scale of 1 (low) to 5 High). Aside from the lab training, site visits, and presentation development, Fellows noted that the opportunity to network with industry persons, see the potential for bioscience careers, and learn about NC's bioscience community were benefits of their experiences. Multiple Fellows also noted that meeting and getting to know the other Fellows and PIs made their experience more positive. As one Fellow explained, "I really enjoyed the company of all the fellows. All fellows were very helpful to me. They always were happy to explain the topics farther to me since I lacked prior knowledge. I knew only math before the fellowship and now I know Bio science and biotechnology."

When asked what had been the greatest impact on them professionally, Fellows indicated that being a part of the BIFP had "expanded their horizons" and helped them understand what to teach to their students to prepare them for jobs in the biotechnology field.
Final comments included:

- Great program. Will recommend to some of my colleagues.
- Site visits were extremely well-organized; guest speakers and hosts at the sites were extremely professional, welcoming, and personable. It was well worth the month's

commitment.

- Thank you for the experience and the hospitality. I will be sure to recommend this to the NSF ATE community.
- I absolutely loved the program. A few things I would suggest are that maybe the program could be cut down to 2 weeks instead of 4. I also feel as though maybe there could be a day off each week to reflect on information presented at the multiple sites; or a chance digest all the information and begin on our modules with that day off. I also think that it imperative that future fellows are notified to bring their own items for the week at NC State.
- Great experience, so glad I went!
- The van was not very comfortable but we made it work.
- The hotel in Asheville was sketchy.

SUMMARY AND DISCUSSION

Survey responses indicate that fellows found their time in North Carolina very informative, professionally powerful, and enriching. Fellows reported that the BIFP helped them better understand biotechnology, including the range of industry occurring in North Carolina. Additional impacts they noted included learning about job opportunities in bioscience and the skill sets needed by those in the field. Fellows reported that their fellowship experiences will translate into them sharing with others about opportunities in the biotechnology field, the skills needed to be employed in this field, and the opportunity to participate in the BIFP.

Much of the success if this fellowship lies in the training provided to Fellows and the site visits in which Fellows participated. Fellows noted that training opportunities provided very useful hands-on experiences and introduced them to labs and lab techniques that they will share with their students. They described site visits as helping them understand the diversity of jobs in the biotechnology field, enabling them to make useful contacts with those in the field and learn about what skills, including the lab techniques that they practiced, were needed by those interested in being employed in this field. Additionally, Fellows reported finding guest speakers' topics interesting and the speakers' enthusiasm infectious.

Although some Fellows struggled with understanding expectations and wanted concrete objectives related to their presentations, most indicated that they had the resources they needed to develop them. Despite this, all appeared pleased with their presentations and noted how useful their development was in helping them summarize what they had learned and identify critical things to share with colleagues or students.

Recommendations

Based on the above findings, there are few recommendations for the BIFP. Most importantly, the program should continue to provide support around the development of Fellows' presentations, including providing time for Fellows to work on them.

APPENDIX

Biosciences Industrial Fellowship Program (BIFP)
Fellows Survey - July 2017

I. Fellowship - General

1. What word or phrase best describes your experience in this fellowship program?

2. Please explain why you chose that word or phrase.

3. Please indicate on a scale of 1 (Not true at all) to 5 (Very true) to what degree the following sentences are true for you.

		1	2	3	4	5
a.	This fellowship helped me better understand what is meant by bioscience.	O	O	O	O	O
b.	This fellowship allowed me to learn or practice lab techniques that are important for me to know.	O	O	O	O	O
c.	This fellowship helped me better understand current areas of bioscience research.	O	O	O	O	O
d.	This fellowship helped me better understand how industry is using bioscience.	O	O	O	O	O
e.	This fellowship helped me better understand aspects of the bioscience industry of which I was unaware.	O	O	O	O	O
f.	I had a clear understanding of the expectations of what the presentation should include.	O	O	O	O	O
g.	I had enough time to develop my presentation.	O	O	O	O	O
h.	I had the necessary resources to develop my presentation.	O	O	O	O	O

II. Learning Module

4. What did you gain by having to develop the learning module?

5. In what ways could development of the learning module be better supported?

6. How do you plan to implement the learning module you developed (please be specific about audiences and context)?

7. Do you have any plans for revising your module based on viewing others' modules or on the feedback you received, and if so, how will you revise it?

III. Guest Speakers and Training

8. Please indicate on a scale of 1 (Not useful at all) to 5 (Very useful), how useful you found the following training opportunities:

	1	2	3	4	5
Bob Rehfuss	O	O	O	O	O
Mike Batalia	O	O	O	O	O
Daniel Herr	O	O	O	O	O

9. What did you like about hearing from these guest speakers?

10. How could the use of guest speakers be improved?

11. Please indicate on a scale of 1 (Not useful at all) to 5 (Very useful), how useful you found the following training opportunities:

	1	2	3	4	5
Cheryl Burrell - Research & Development Lab Techniques	O	O	O	O	O
Kristina Burgess - Upstream Processing and Gowning	O	O	O	O	O
Bill Woodruff – Bio-Processing	O	O	O	O	O
Denise Schweizer – Analytical Chemistry	O	O	O	O	O
Forsyth Tech / NC BioWorks Analytical Molecular Training Lab	O	O	O	O	O

12. What did you like about these training opportunities?

13. In what ways could these training opportunities be improved?

IV. Site Visits

14. Please indicate on a scale of 1 (Not useful at all) to 5 (Very useful), how useful you found the following site visits:

	1	2	3	4	5
a. Joint School of Nanoscience (Greensboro)	O	O	O	O	O
b. High Point Clinical Trials (High Point)	O	O	O	O	O
c. NC Research Campus	O	O	O	O	O
d. Biogen (Raleigh)	O	O	O	O	O
e. NC Biotech Center	O	O	O	O	O
f. BioNetwork Capstone Center (Asheville)	O	O	O	O	O

g.	Novozymes (RTP)	O	O	O	O	O
h.	B.R.I.T.E. (Durham)	O	O	O	O	O
i.	Wake Forest Institute for Regenerative Medicine	O	O	O	O	O
j.	Piedmont Pharmaceuticals (Greensboro)	O	O	O	O	O
k.	Carolina Liquid Chemistries (Winston-Salem)	O	O	O	O	O
l.	Carolina Bio	O	O	O	O	O
m.	Pfizer	O	O	O	O	O

15. What did you like about these site visits?

16. In what ways could these site visits be improved?

V. Impact

17. On a scale of 1 (Very little) to 5 (Very strong), overall, how would you rate the past four weeks in terms of its impact on you professionally?

1	2	3	4	5
O	O	O	O	O

18. Aside from the lab training, site visits, and module development, were there any other things that had an impact on your experiences? If so, please describe.

19. What has been the greatest impact on you professionally of the last four weeks?

20. How will this impact translate into what you do professionally?

21. Is there anything else that you would like to add?