

**NIMBioS**

**Evaluation Report**

**SUMMER RESEARCH EXPERIENCES  
FOR UNDERGRADUATES AND TEACHERS**

**JUNE 6 - JULY 29, 2016**

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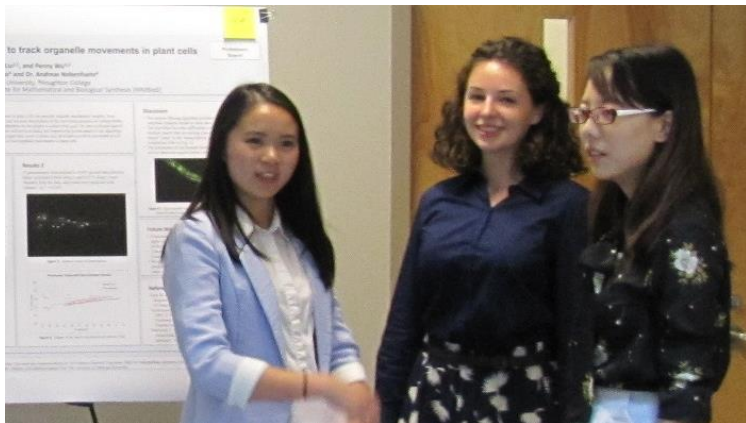
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# Table of Contents

<b>2016 Projects and Participants</b>	<b>1</b>
<b>Participant Satisfaction</b>	<b>3</b>
<b>Usefulness of lectures and sessions</b>	<b>5</b>
<b>Satisfaction with accommodations</b>	<b>6</b>
<b>Graduate School Plans</b>	<b>6</b>
<b>Additional Participant Findings</b>	<b>7</b>
<b>Participants' Satisfaction with Mentors</b>	<b>10</b>
<b>Program Impact</b>	<b>11</b>
<b>Mentor Satisfaction</b>	<b>12</b>

## 2016 Projects and Participants

### Using statistical filters to follow fast organelle movements in plant cells

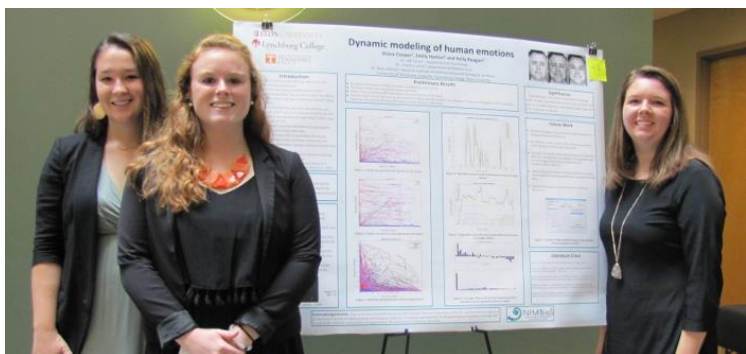


**Participants:** Alanna Gary (Univ. of Chicago), Vera Liu (Rice Univ.), and Penny Wu (Houghton College)

**Mentors:** Dr. Vasileios Maroulas, Mathematics, UTK; Dr. Andreas Nebenfuhr, Biochemistry & Cellular and Molecular Biology (BCMB), UTK

Plant cells display some of the fastest intracellular movements of all eukaryotic organisms. While easy to observe, we still know very little about the mechanisms that drive these movements or their biological function. To gain a better understanding, it is necessary to obtain a detailed description of the movement patterns in a cell. This description is complicated by the enormous complexity of these movements where many particles show highly variable speeds and directions. This project utilized a novel approach based on statistical particle filtering to obtain more reliable track descriptions for quantitative analysis.

### Dynamic modeling of human emotion

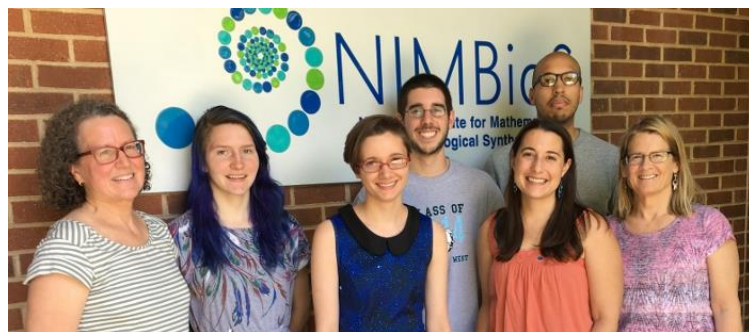


**Participants:** Alana Cooper (Univ. of Tennessee, Knoxville), Emily Horton (Lynchburg College), and Kelly Reagan (Elon Univ.)

**Mentors:** Dr. Jeff Larsen, Psychology, UTK; Dr. Charles Collins, Mathematics, UTK; Dr. Nels Johnson, NIMBioS Postdoctoral Fellow

The scientific study of human emotion is challenging because emotions involve a variety of components, including conscious experiences (e.g., feelings of happiness and sadness) and facial microexpressions (e.g., smiles and frowns). Moreover, the components operate over different time scales: feelings can persist for minutes or hours, but facial expressions can come and go within the space of a second. Using rich databases collected as people watched evocative film clips, students used dynamic modeling in order to better understand how emotions unfold over time.

## Mouse trap! Modeling the spread of mice & hantavirus in pressured landscapes

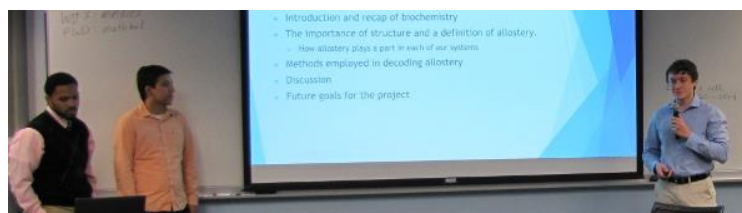


**Participants:** Jeff DeSalu (The Ohio State Univ.), Morganne Igoe (Univ. of the Minnesota-Twin Cities), Joey Moran (Unity College), and Theresa Sheets (Univ. of Maryland-Baltimore County)

**Mentors:** Dr. Colleen Jonsson, NIMBioS Director; Microbiology, UTK; Dr. Suzanne Lenhart, NIMBioS Assoc. Director for Education and Outreach; Mathematics, UTK; Dr. Megan Rúa, NIMBioS Postdoctoral Fellow

More than half of all human infectious diseases originate from spillover of RNA viruses from wildlife. Globalization, environmental and anthropogenic changes promote opportunities for spillover and emergence of RNA viruses from wildlife to humans. For rodent-borne zoonotic viruses, abiotic pressures may comprise alterations in climate and landscape that alter habitat (e.g. size, composition, fragmentation), resource availability (e.g. water, food), and/or rodent community structure (e.g. species richness and diversity, population abundance and structure). These drive contact rates and host well-being. To investigate the effects of different landscapes and resources on hantavirus spread in mice populations, this group built a model representing the population structure and virus spread. The group used data from sites with different ecological features and multiple traps to help formulate and parameterize the model.

## Decoding allosteric by mathematical analysis of molecular dynamics simulations



**Participants:** Joshua Darville (Fisk Univ.), Elman Gonzales (East Tennessee State Univ.), and Jan Siess (Rutgers Univ.)

**Mentors:** Dr. Quentin Johnson, NIMBioS Postdoctoral Fellow  
Dr. Tongye Shen, Biochemistry & Cellular and Molecular Biology (BCMB), UTK

Allostery is a fundamental regulatory process, by which a biomolecule (or molecular complex) transmits a signal from one location to another distant site by a complex and seemingly invisible molecular interaction network. This cooperative interaction (molecular cross-talk) has been found to be integral in many biological functions such as oxygen binding, enzyme regulation, and immune response. We will utilize a newly developed computational tool for the detection of allostery to investigate a nuclear receptor complex, a family of allosteric proteins that are key in transcriptional regulation. This project will involve using state of the art super computers to perform molecular dynamics simulations and analyze simulation trajectories using novel data reduction techniques. The goal of the project is to further our understanding of allostery in general and in advanced situations (such as negative allostery and promiscuous regulation); ultimately this work will lead to the future design of biomolecular switches. understand how emotions unfold over time.



**Participants:** Samuel Iselin (Valparaiso Univ.), Howsikan Kugathasan (Fisk Univ.), and Jacob Miller (Univ. of Kentucky)

**Mentors:** Dr. Susan Riechert, Ecology and Evolutionary Biology, UTK; Dr. Michael Jantz, Electrical Engineering and Computer Science, UTK; Kelly Sturner, Education and Outreach Coordinator, NIMBioS

This team aimed to reconfigure physical exercises associated with the Biology in a Box Project Fossil unit into computer simulation games. The idea was to offer novel learning experiences that were structured as entertaining games rather than merely tutorials and exercises. For example, in testing a player's understanding of scientific notation, we might require he or she to run an avatar down a geological time line within x seconds to locate periods drawn from a 'hat'. The time line will be in different notation from the time drawn, necessitating conversion. This game mirrors an exercise from the Biology in a Box Fossil unit: Geological Time Scale. The team also had an option to develop a game that utilizes our existing 3D Cambrian World populated by 22 species. Players would be introduced to the evolutionary history of biodiversity through game play. They would explore the three ancient sea worlds from a first person perspective under the challenge of capturing images of the 'living' forms of fossils (see image for an example). In this sense the game is similar to a museum panorama or zoo exhibit.

### Participant Satisfaction (100% response rate)



#### SRE Participants' comments:

“ I love NIMBioS so much! This is the place which motivates me to be a great scholar and research so that I could motivate others in the future!  
 I'm very thankful for my experience at NIMBioS!  
 Thank you for a wonderful research experience!!

100% of 2016 SRE Participants would recommend the program to others.

## Reasons for recommending the program to others:



☺☺ I think it provides an invaluable opportunity to gauge one's interest in graduate school and scholarly research as a career path, in or out of the academy. I also felt it provided access to individuals and resources not typically encountered in undergraduate STEM programs – at least, not so extensively.

NIMBioS is a great platform for undergrads to explore/confirm their interests in interdisciplinary research. All the projects required collaboration with scholars coming from different fields of study. The faculties and staff at NIMBioS are really supportive to SRE students as well, so you will not feel left out even you are weak in some area that you haven't studied before you come here for research.

Wonderful faculty, variety of fun experiences, flexible schedule, wonderful peers

Exhausts all aspects of research.

I had an amazing time. I learned so much and I know I will take that knowledge with me into my future career.

This program was a great way to get experience with a realistic research project. It helped me develop many new and important skills and helped me determine what kind of research I enjoy. Overall it was just a very valuable experience.

It was very immersive and was the most helpful thing I have done in my academic career for determining my future direction.

I had a great time, learned a lot, and felt that I was doing valuable work.

I think it's a very unique experience due to the interdisciplinary aspect. Hence, it would be primarily for that reason why I would recommend this program to another.

Because it is a great learning experience and it is a great introduction for those who are interested in research.

I learned a lot and enjoyed the program

Because it is an excellent program to get exposed to interdisciplinary work, make connections with others in your field, get experience working in an academic group, and practice performing real salient research.

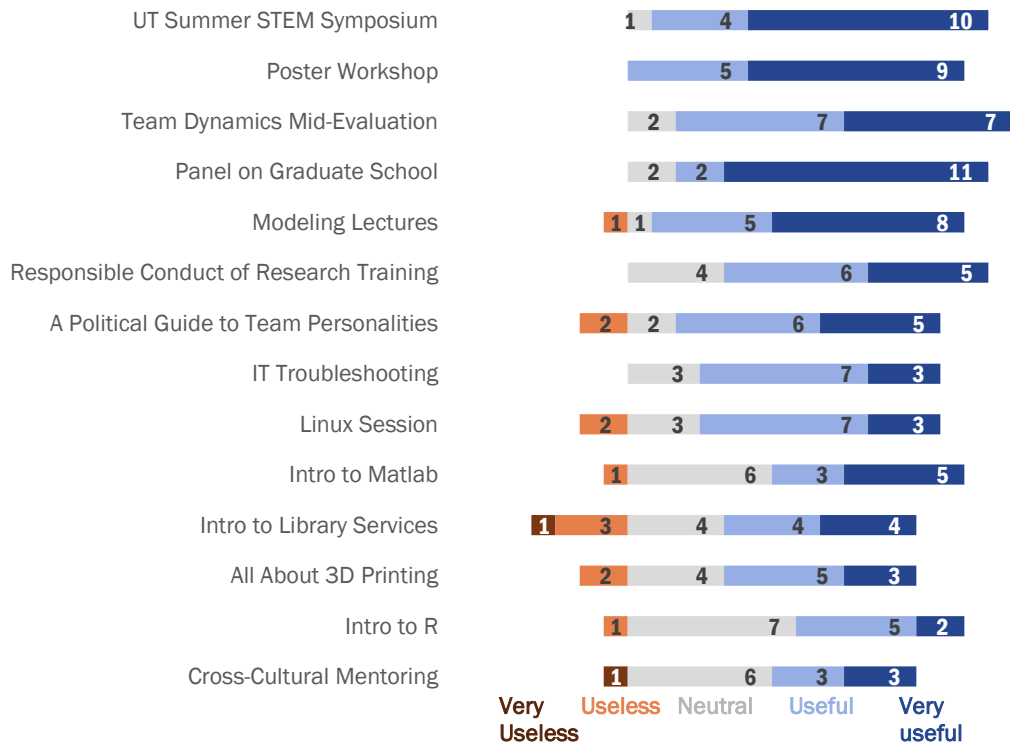
Interdisciplinary research is critical in the 21st century.

NIMBioS is not quite well known to my peers in my school (at least for me, I haven't ever heard of this until I searched online for stat/math/bio summer research program). This was such a great experience for meeting with people, and learning about research, and having fun! There's a pretty big bio department in my school so I'm pretty sure there would be plenty of people interested in this once they know there's such an institution that offers such a great summer experience.

First, it's a good program for deciding whether or not research is something you're interested in pursuing further. NIMBioS is also an incredible place for meeting researchers from all fields, and talking to these folks can help SRE students refine their academic trajectory (or plan an entirely new one!). Collaboration is a huge skill to have in research, and I don't think it's something many undergrads have much experience in. Lastly, the program itself is attractive with its excellent pay and free housing, so people that might otherwise not have been able to do research have an opportunity to do so.

This program does an excellent job of giving students a taste of academic research with plenty of support and encouragement. I think it was an engaging, challenging, and well-developed program.

## Usefulness of lectures and sessions



### Other lectures participants found valuable:

#### Informal group reports

##### Math Graduate School session

Dr. Lou Gross gave a lecture on modeling that was more philosophical and conceptual than Dr. Lenhart's was. As a person with no math background, I found the differing perspective -- and the increased breadth -- very insightful.

I enjoyed the optimal control lecture and when Dr. Lou Gross talked about grad school.

Our group was invited to ETSU to give a special presentation to their REU about our research. This was both a fantastic and insightful experience.

### Comments about lectures or sessions:

In general, I think the lectures about modeling and software are really helpful and supportive toward our own research, but I feel like for some topics only one session is not enough, for example MATLAB. I know that most of the groups had to use MATLAB more or less, but I found what we have covered in the lecture was not enough for us to go on our own. I wish the lecture could go more in depth.

I found all sessions interesting, but there were some a little more tailored to my project.

I found the lectures in general to be very informative and well-suited to our needs and interests.

I think that there could have easily been more modeling lectures. They were very interesting and it was cool to learn from people that are so accomplished.



## Satisfaction with accommodations



**88% satisfied** with housing.  
(1 very dissatisfied)



**88% satisfied** with computing resources.



**88% satisfied** with extracurricular activities.  
(1 very dissatisfied)



**81% satisfied** with mail service.

### Additional accommodations/supports needed:

**Kitchen supplies, pots, pans...**

Maintenance never fixed my leaking window. They said "Yea that happens".

It wasn't a problem for my group until the last few days, but for the future SRE students, it'd be a really good idea to get parallelized MATLAB running on the 28-core computer.

I asked for specific housing accommodations for my anxiety and it was supplied. It would have been nice to have a microwave in the apartment, but having one at NIMBioS was sufficient.

## Graduate School Plans



SRE Participants indicated the experience impacted their plans for graduate school.

Explanations for how research experience impacted plans to go to graduate school:

**“**I have been on the fence about graduate school for a while. I'm fairly certain that I'll end up going, but I am not exactly sure for what. This program gave me my first taste into academic research. While I may not choose to be a researcher as a career choice, I found the experience very eye-opening and motivating to experience research in other contexts.**”**

All of the information provided and the experience I gained reinforced my desire to attend graduate school.

I feel much more prepared and confident in my abilities as not just a student, but a researcher working on a project. One of the (very few!) things I was mildly annoyed with this summer was that there was a lot of metaphorical hand-holding, with the mentors setting goals for us and telling us interesting things to investigate. This is great, and I learned so much from this! But I found that I was itching to go and investigate interesting things and tangents on my own, without such close guidance. I had not identified this independence in myself before, and I think I feel less intimidated about grad school now.

I was not sure if I should get a Ph.D or a master degree at first, but after this SRE I am sure that I will pursue a Ph.D degree, because I found my passion in doing research and I enjoyed very much interdisciplinary collaboration.

I am definitely going to go to grad school and I am more confident about the process

Now I want to go.

The experience as a whole reaffirmed my interest in academic research, and specifically interdisciplinary research.

Before I knew I wanted to go to graduate school, but now I have been able to focus in on the specific area that I want to go to grad school for. Before I wasn't sure if I wanted to get a masters or PhD, but now I know that I want a PhD program. The faculty at NIMBioS were super helpful and met with me one on one to help me find schools and professors that would be a good fit for me.


Solidified my desire.

I now have a better idea of what graduate school is like and the reasons for continuing onto graduate school. Although I am still uncertain as to if or where I will want to go, I now have a much better understanding of those decisions.

Helped me learn about interdisciplinary research.

## Additional Participant Findings

- 13** out of **16** SRE Participants hope to complete a **doctoral degree**.  
(Aspirations remained the same from pre to post, except for one person who changed their hopes from a Master's degree at pre-survey to doctoral at post-survey.)
- 2** out of **16** SRE Participants hope to complete a **Master's degree**.
- 1** out of **16** SRE Participants hope to complete a **Bachelor's degree**.



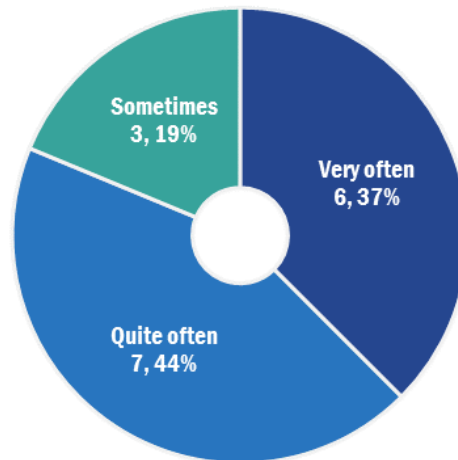
**Basecamp**

**11** SRE students felt Basecamp was a useful means of communicating within the SRE group.

**3** SRE students did not feel it was useful.

**2** SRE students did not use Basecamp.

How often participants felt their groups worked well together

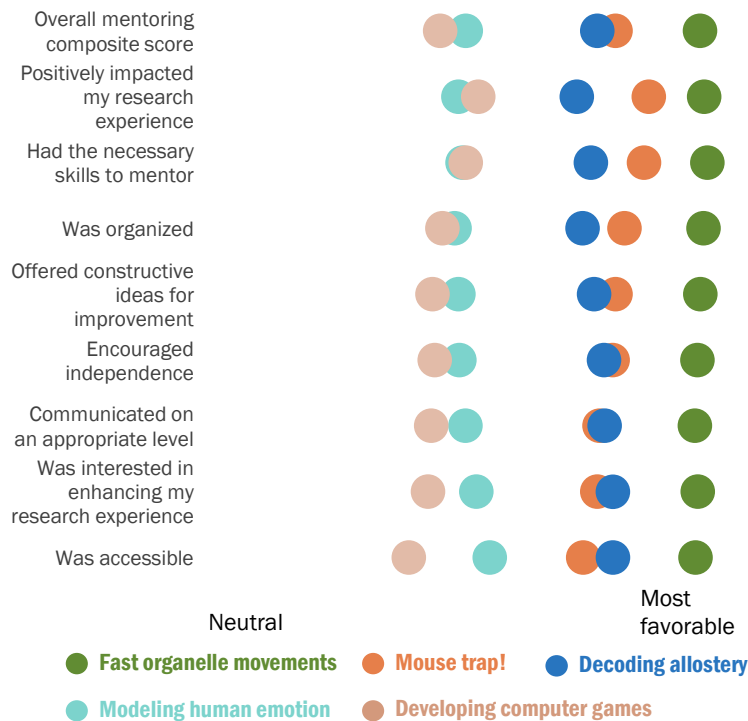




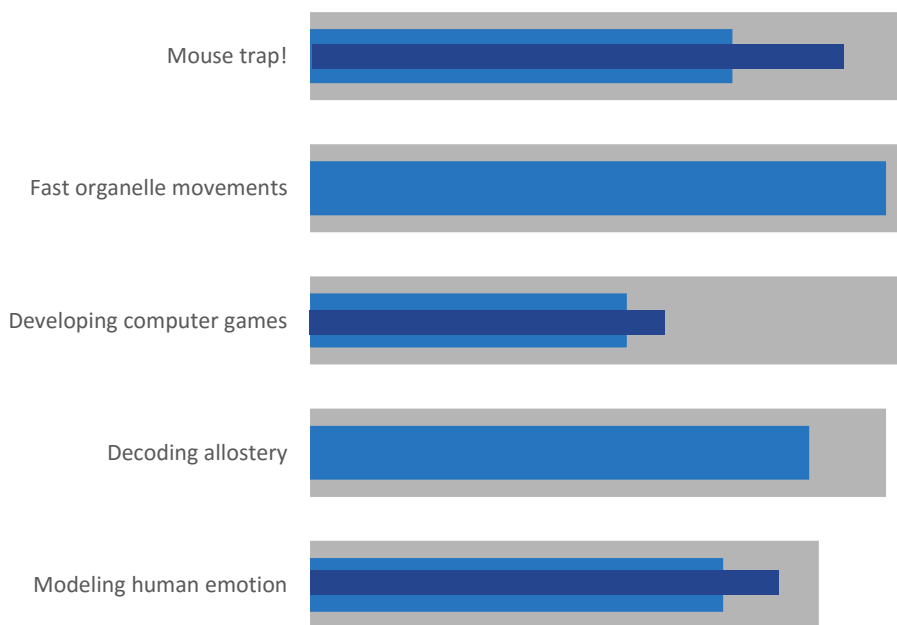


## Participant Satisfaction with Mentors

### Aggregated assessment of mentors by research group



### Overall comparison of total mentoring composite scores of mentors within project assignment groups



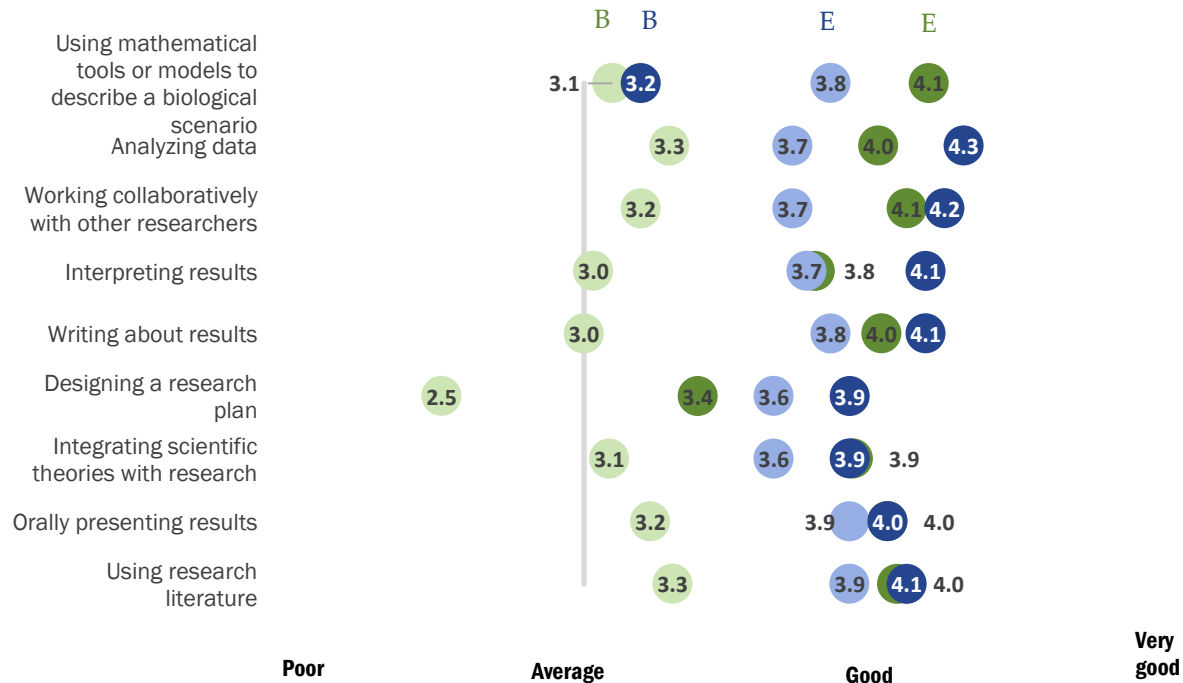
#### Additional comments:

“ Dr. Larsen was so wonderful, he just had too many ideas and needed to be more organized. It would have been nice to have a to-do list. Nels did not contribute much to our project, but he was very helpful when it came to writing our report and putting together our presentation.

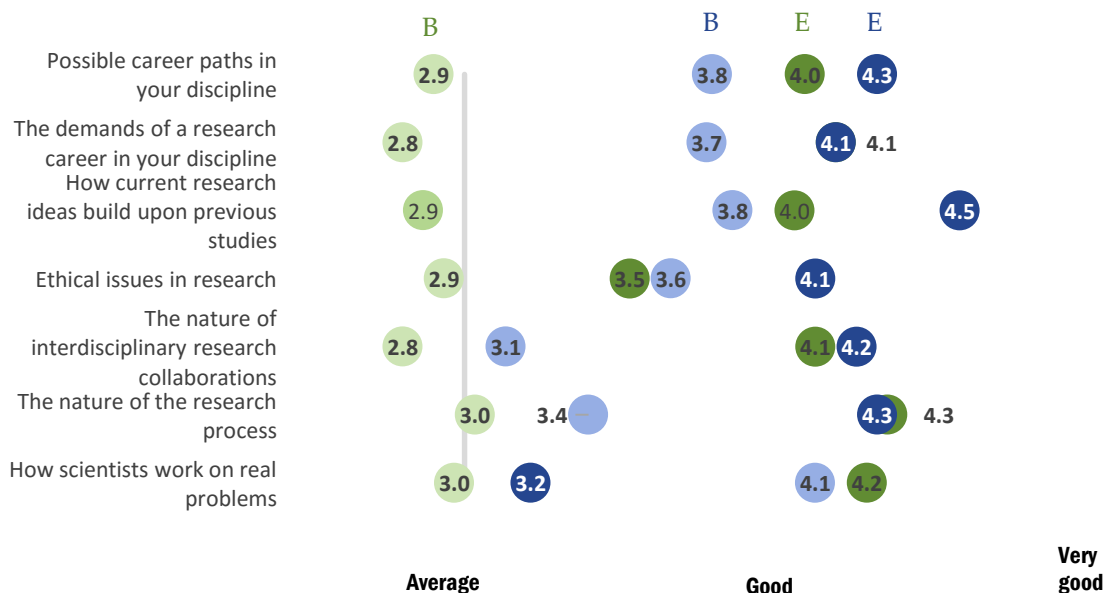
It did, admittedly, seem as though communication and coordination between the mentors was at times lacking, and that this had something of an impact on our ability to function as a group. However, this seems to be something of an ongoing issue in interdisciplinary fields, and upon reflection, I felt that exposure to the demands of cross-field communication, and the potential for a breakdown of those communications when parties cannot interact on the same terms, was ultimately productive and prepared me for some of the logistical hurdles that I might encounter should I pursue a career in interdisciplinary research.

## Program Impact

SRE participants and mentors rated research skills of SRE participants at the beginning (B) and end (E) of the program. Overall increases were evident across research skills. The decrease in SRE participants' scores for 'Using mathematical tools or models to describe a biological scenario' may be due to an overestimation of their skills at the beginning.

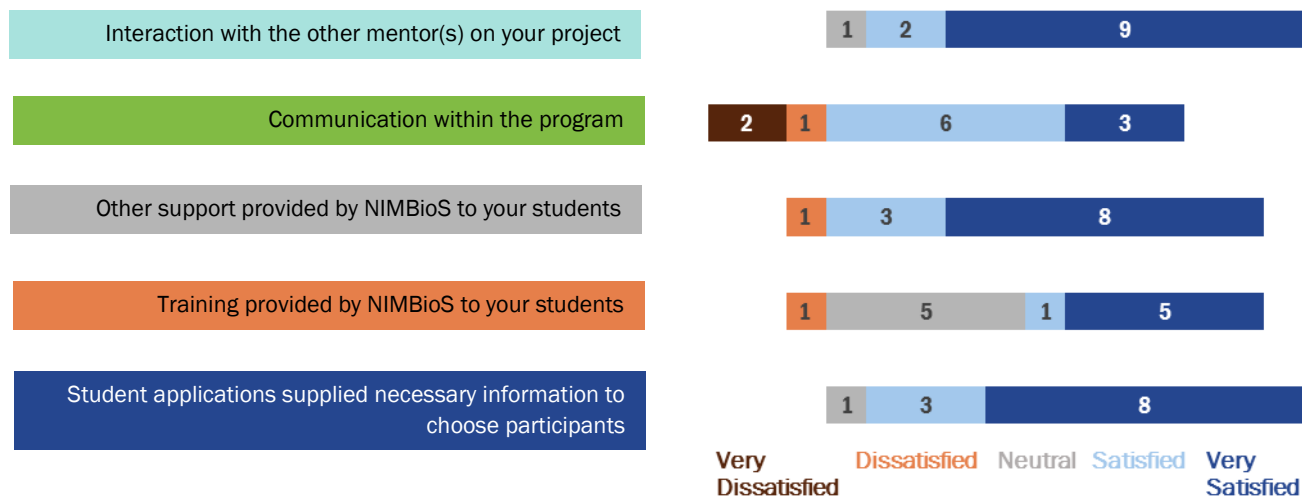


SRE participants and mentors rated knowledge of SRE participants about scientific careers and the research process at the beginning (B) and end (E) of the program. Overall increases were evident across knowledge areas. The decrease in SRE participants' scores for 'How scientists work on real problems' may be due to an overestimation of their knowledge at the beginning.



## Mentor Satisfaction (92% response rate)

Associated comments in color-coded boxes below chart.



One of the mentors was actively involved in the project and the other was not. It felt very much that she was not committed to the project.

I sometimes misplaced information when an email on topic X included information about topic Y as well. Separate emails would have made it easier to locate the information I needed.

This was the most aggravating part of the entire program for me. I am a postdoctoral fellow who was actively working as a mentor with the group, yet I was consistently left off email correspondences. This led to issues within the group as the students knew more about what was going on than I did and undercut my ability to effectively mentor the students. I wasn't even provided with a program schedule and when I queried the organizers for one, I was made to feel that I was over stepping my bounds, and then when I had a conflict with an event I was expected to attend, I was made to feel that I was shirking my duties when I didn't even know there was an event scheduled since I wasn't informed of the schedule.

Email communication was fine

My students requested a cluster to compute. It seems that it did not work out and lots of issues existed and students got discouraged.

Instead of ranking their preference, they could just list them. I got students who had my project as a second preference, they still accepted the NIMBioS offer and they were super fantastic...

I wonder if more could be done to distinguish between math and stats experience. My team was great at math but more understanding of stats would have been helpful.

Include the students' exact major.

All three students were more qualified to complete the work than I expected of applicants.

I did my own training...

For those students new to various software packages, it would be nice to have some follow up times for them to get more hands-on support.

The "training" the students received was too brief. It's unreasonable to assume that a basic one hour introduction serves as proper training. It would be nice if an advanced session in R and/or Matlab were offered that would be optional for those students whose projects require these skills to obtain further instruction.

Not particularly useful to this team which was computer oriented. One was a math major, however, so I expect he found this section useful.

The training provided was not relevant to our project. I think the training sessions should not be mandatory.

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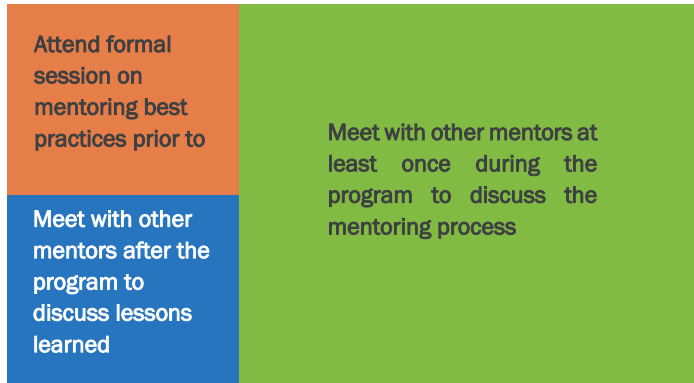
out

of

11

Mentors do not feel additional mentoring or training is necessary.

Treemap to depict training preferences of the four mentors indicating a preference for additional training. Mentors could select more than one training preference.



#### Comments:

**I feel like I get so much out of the program that things like this would help you get return on your investment. You tell me when and where to go and I'll be there.**

**It would also be good to include the organizers so everyone can be on the same page.**

Additional comments or suggestions for improving the program next year:



I think I would have done a better job and the students would have gotten more out of it if one of my jobs was to assign them some preliminary reading ahead of time so that they'd be ready to hit the ground running when they got here. I suppose I could have asked you whether that was OK for me to do in May but it didn't occur to me.

Overall i think it is extremely positive experience for all three members from our team and i can see it is true for some other teams. somehow the team chemistry was not fully there for our team. i am not sure over emphasizing equal contribution from all members help. science cannot be totally quantified as equal work. it makes things awkward when we assign task etc. they are at different stage of development and have different background. on the other hand, i think some members transport daily from home while others stay at the lodging provided with nimbios is not a good idea.

1st: It was hard to answer categorical questions about individuals as Computer gaming development was different from developing mathematical models to solve a research question. The students seemed to prefer to work independently of one another on projects. My only suggestion would be that two meetings a week was excessive for this team as we communicated extensively back and forth throughout the week and on weekends through email. Finding something to talk about in a forced meeting was wasted time. Once a week is a must, however.