SEE WHERE OUR STUDENTS ARE NOW!
See the composition of our recent alumni and where they head after NC State!
Turn to p.3 to learn more!

NEW EQUIPMENT, CLASSES, AND MORE!
We have new equipment for our BIT modules, including a new course offering in the fall!
Turn to p.7 to learn more!

INSTRUCTORS, NEW AND RETURNING!
In addition to our three faculty members, we’ve hired three new postdoctoral scholars!
Turn to p.9 to learn more!

WELCOME!
BIT Website
BIT Twitter
BIT LinkedIn

Join our team!
Coming soon:
Postdoc opening
Post-bac opening
From the Director

Dear BIT Alumni and Friends:

Over the past 20 years, more than 6,000 undergraduate, graduate, and postdoctoral students (and Faculty) have taken BIT lab courses - most of whom took our Core Technologies class that covers fundamental lab skills in molecular biotechnology. It is great that so many of you have gone on to very successful careers in industry, academia and government that leverage your BIT experience at NC State. It is always nice to encounter our Alumni as I travel within North Carolina, but also across the U.S. and around the world. The demand for BIT courses continues to increase and we find that the breadth of disciplines impacted by molecular biotechnology is ever expanding. As you can read in this Newsletter, BIT Faculty and Instructors try to keep up with new developments in the life sciences by updating the Core Technologies course and by adding new Laboratory Modules that cover emerging areas. During the pandemic, we even learned how to teach our lab courses in a virtual format!

We are launching this Newsletter to keep our Alumni and Friends abreast of changes in the BIT Program and to encourage you to let us know how you are doing and provide feedback on your experience here. Thanks for being such great ambassadors of our Program and please keep making us proud with your accomplishments.

All the best,

Robert M. Kelly
Alcoa Professor of Chemical and Biomolecular Engineering
Director, NC State Biotechnology (BIT) Program
Email: rmkelly@ncsu.edu
Colleges of Students Enrolled 2020-21
- College of Sciences
- College of Engineering
- College of Agriculture and Life Sciences
- The Graduate School

Types of Post Grad Plans for Students
- Continuing Education
  - Masters
  - PhD
  - Medical Degree
  - MBA
  - PharmD

Majors of Students Enrolled 2020-21
- Zoology
- Soil Science
- Polymer and Color Chemistry
- Plant and Soil Sciences
- Nuclear Engineering
- Crop Science
- Chemistry
- Animal Science
- Plant Biology
- Nutrition Science
- Microbiology Ag & Life Sci
- Bioprocessing Engineering
- Biomanufacturing
- Materials Science and Engr
- Comp Biomedical Sci
- Biomedical Engineering
- Horticulture Science
- Biochemistry
- Microbiology
- Genetics
- Microbial BioTech
- Biomedical and Health Science...
- Physiology
- Biological Sciences
- Chemical Engineering
I felt really prepared to enter my tenure-track teaching position because of my experience at BIT. I understood what I needed to do for lecture prep; I was familiar with using course management technology, classroom technology, and active teaching methods. I also knew what needed to be done to plan and teach my new lab course. Although the course itself is not new, I decided to change the course completely to incorporate my own research, and I felt capable undertaking these change in the first year that I taught the course. My experience at BIT also taught me about how to set-up my own lab and gave me a good idea of the types of equipment that I would need in order to do the research that I wanted to do. This not only helped with start-up once I got to my new position, but also helped during the interview process since I could evaluate the resources that the institutions would be able to provide.

The teaching postdoctoral position I had in BIT was transformative. I was successful at securing a tenure-track faculty position during my first job search. Importantly, I had been introduced to evidence-based teaching techniques as well as the scholarship of teaching and learning while in the BIT program. Those experiences allowed me to confidently make pedagogical decisions as a new faculty member. I also entered my current institution with extremely valuable course design experience. The transition from researcher to professor is not an easy one. The skill set needed to be an effective teacher and mentor is huge and I know that the teaching postdoctoral program helped me begin assembling that skill set. Finally, the mentorship I received at NCSU was phenomenal. Everyone there was supportive of my work and opened up my eyes to so many new professional opportunities.

I was granted tenure and promotion to Associate Professor in 2019. I also received an NIH AREA award and the 4th edition of Molecular Biology Techniques was published (coauthored with BIT alumni Susan Carson, Scott Witherow, and Melissa Srougi). I was also named the Wanek School of Natural Sciences Teaching and Learning Specialist. In this role, I promote scholarly teaching among our Biology, Chemistry, and Physics departments and created a peer review of teaching protocol that is used school-wide.
Teaching Adaptations

When last spring was interrupted and classes were sent online, many of the biotechnology modules were able to pivot by examining data collected from years of previous classes. To supplement that analysis this year, the Biotechnology Program instructors created videos demonstrating all the necessary lab processes. Dr. Sengupta and Dr. Chen, inspired by similar videos that were made for the chemistry labs, created videos for both BIT 410/510 and BIT 473/573. The videos were originally intended to supplement a limited amount of lab time, but after the fall semester was once again sent online, they became even more important.

The BIT 410/510 videos were spearheaded by Dr. Sengupta, and were especially important, as most of the skills learned in that class are important for other BIT classes and the larger biotechnology field. These videos were filmed across the lab bench from the instructor performing the experiment, in order to give students the best vantage point.

Dr. Chen worked on her own to create videos for her BIT 473/573 module. The videos were filmed by strapping an Akaso, similar to a GoPro, to Dr. Chen’s head, allowing the videos to be first person perspective. They pause frequently to show important details, and PlayPosit was later added, so that students could choose different actions as they watched the videos. Dr. Chen intends to keep these videos as part of the class moving forward, in order to better prepare students for the lab and to minimize mistakes.
Due to COVID-19 restrictions last year, the annual BIT-SURE program had to be conducted entirely online. This limited the number of students who were able to participate to just four and meant that their projects had to be altered in order to be effective in an online environment. Luckily, much of the research in the Biotechnology Program involves a great deal of data analysis.

One of the participating students, Helena Hysong, used various programs and processes to analyze “p53 mRNA structure and envision their reactions under stress.” She then used published research to contextualize her results and to help design future research directions.

Another student, John Joyce, sequenced and analyzed the genome of a particular strain of *E. coli* and then “used Next Generation Sequencing and a program called Breseq to align genomes to the founder strain.” He then conducted an analysis of the mutations and combined this with a literature review in order to “identify potential genetic factors involved in the new phenotype.” The main skills he gained from this experience include conducting background research and collaborating with other students. He believes that these skills will be “very useful in graduate school and beyond.” Similarly, Helena feels that her main takeaway from the program was learning “how to look through published research to build a foundation for a new project,” an important skill for any researcher.

Despite challenges faced in both adapting research and researchers to working entirely online, the 2020 BIT SURE Program still proved a success and was able to continue its legacy for another year. The 2021 program will be able to welcome eight students to campus to work in a hybrid format, in which some time will be spent working at home and some time will be spent in the lab.

<table>
<thead>
<tr>
<th>Student</th>
<th>Research Project</th>
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<tbody>
<tr>
<td>Helena Hysong</td>
<td>Using SHAPE-MaP to visualize structural changes in the p53 mRNA 5’ UTR under stressed conditions</td>
</tr>
<tr>
<td>Mohammad Khan</td>
<td>Using SHAPE-MaP to build secondary structure models of mRNA 5’ UTR of cancer related genes</td>
</tr>
<tr>
<td>Rose Krebs</td>
<td>Analysing the <em>del</em> Gene Cluster for Gold Biomineralization Across <em>Delftia spp.</em></td>
</tr>
<tr>
<td>John Joyce</td>
<td>Virtual metabolic pathway reconstruction of <em>E. coli</em> strain K12 MG1655 evolved to use ethylene glycol (EG) as a sole carbon source</td>
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New Equipment

Though the Biotechnology Program wasn’t able to host in person labs for the first semester of the year, and had to alter their lab offerings in the spring, we were able to purchase new pieces of equipment, which will be useful in many BIT modules when normal labs resume.

### Agilent Tape Station 4150

This machine quantifies and determines the size, quantity, and integrity of nucleic acid samples. It will be used in the following BIT modules: High-Throughput Discovery, Biotechnology & Sustainability, Environmental Biotechnology, Metagenomics, Plant Genetic Engineering, Plant Genomics, Manipulation of Recombinant DNA, Environmental DNA, and RNA World.

### BioTek Lionheart FX

This machine is a Quantitative High-Throughput imaging station, which can capture a broad range of organisms, including but not limited to yeast, bacteria, and mammalian 2D and 3D cultures as well as others. It will be used in the following BIT modules: Yeast Metabolic Engineering, Cancer Drug Discovery, Biotechnology & Sustainability, High-Throughput Discovery and Protein Interactions.

### QIAGEN Tissue Lyser II

This machine is capable of high-throughput lysis of up to ninety-six samples in a consistent way. It will be used in several BIT classes: RNAi, Cancer Bio, High-Throughput Discovery, Metagenomics, Yeast Metabolic Engineering, Plant Genomics, and Directed Evolution.
Digital PCR allows for sensitive detection and quantification of nucleic acids, while the QIAcuity system uses special plates that feature partitions and an easy-to-use setup. This will be most useful in these BIT courses: Metagenomics, Yeast Metabolic Engineering, and High-Throughput Discovery.

The HEPA filter units will allow our two Opentrons OT-2 instruments to be used for sample aliquoting, tissue culture, and drug screening for several workflows used in courses. It will be used in these BIT modules: High-Throughput Discovery, Cancer Bio, Metagenomics, and the planned BIT 295 Biotechnology & Sustainability.

This machine expands our protein testing capabilities and allows us to determine binding kinetics, quantify targets of interest, and detect biomolecules. It will be used in Protein Interactions, High-Throughput Discovery, and other BIT modules.
Like most professors, Dr. Srougi had to make substantial changes to her courses and the way she taught them as a result of COVID-19. This past year, she taught BIT 100 Current Topics in Biotechnology, BIT 410/510 Manipulation of Recombinant DNA, BIT 471/571 RNA interference and Model Organisms, and BIT 495/595 CRISPR Technologies. Her classes were flipped, so that students watched pre-recorded lectures and then used the class time for discussion. She said that working with this new format “really made [her] focus on accessibility for students.” The hardest thing for her to get used to while teaching over Zoom has been “the abyss of endless black panels in the zoom room.” Her lab will be “ramping up” a number of new undergraduate research projects as restrictions (hopefully) begin to ease at the University.

This past year, Dr. Goller taught BIT 477/577 Metagenomics, BIT 479/579 High-throughput Discovery, and BIT 480/580 Yeast Metabolic Engineering. He adapted his courses to teaching online by creating collaborative projects that students complete, which allow them learn concepts which normally would have been taught in the lab. “Each student brings a lot to the course,” he said, “The creativity and motivation participants brought, along with some flexibility, helped keep us on track to reach our course objectives.” Dr. Goller also values students’ patience in classes, as he has tried to come up with options for replacing in-person interactions. Even though teaching online has been hard for everyone involved, he is excited to continue implementing new strategies, even as classes shift back to in-person. He will be a mentor for the 2021 BIT-SURE program, and he’s looking forward to launching BIT 295 Biotechnology & Sustainability in the spring of 2022.

Between the fall and spring semesters, Dr. Chen taught or co-taught five courses: BIT 410/510 Manipulation of Recombinant DNA, BIT 473/573 Protein Interactions, BIT 495/595 Virus Biotech, BIT 402/502 Biotechnology Networking & Professional Development, and BIT 501 Ethical Issues in Biotechnology. She also flipped her lectures: Students watched lectures outside of class and then spent in class time on case studies or data analysis. She also had to translate the lab portion of the class to an online format, which included making first-person videos that allowed the students to see how lab procedures were done. “I plan to continue using these as pre-labs in future semesters,” she said. Dr. Chen also misses in-person classes, and has found it hard to adjust to all of her students having their cameras turned off in class. She’s looking forward to reflecting on the past year over the summer, and to the opportunity to test out the new instrumentation the Program has gained.
Postdoc Profiles

Dr. Jacob Dums, who is an alumnus of NC State with a PhD in molecular plant biology, started as a BIT postdoctoral teaching scholar in August 2020. This year, Dr. Dums taught two sections of our main BIT 410/510 Manipulation of Recombinant DNA course, co-taught the first-year inquiry (FYI) course BIT 100 Current Topics in Biotechnology, and BIT 402/502 Biotechnology Networking & Professional Development. He will be serving as a mentor for the 2021 BIT SURE program, where he will conduct a research program in algae virus biology and biotechnology. While he’s excited for the experience of conducting this research, he’s more excited about the opportunity to interact with students: “I still like research, but I really prefer to mentor students.” As someone who continues to “treasure” many of the mentors he’s had, he thinks of mentoring as a way to pay it forward. Dr. Dums will also be using his research to revitalize BIT’s Plant Genetic Engineering course in the fall.

Dr. Carly Sjogren, who is a graduate of UC-Riverside and is most recently coming from a postdoc position at UNC-Chapel Hill, started in December 2020. She has been working in plant biology for most of her research career, but one aspect of the move to NC State that excites her is the opportunity to move to a focus on crop biotechnology. She will also be serving as a research mentor for the 2021 BIT SURE program as she begins this research transition. Like many of the instructors in the Biotechnology Program, she is passionate about both the science and the mentorship aspect of the postdoc program, but she is particularly interested in mentoring students in a research setting. “I see getting to train students to be researchers as much more fulfilling,” she said. Dr. Sjogren taught BIT 410/510 Manipulation of Recombinant DNA and co-taught BIT 479/579 High-Throughput Discovery and BIT 501 Ethical Issues in Biotechnology this year.

Dr. Andrew Hasley joined us in December 2020 from Minnesota, where he previously worked at BioQUEST and helped train instructors to use Universal Design for Learning. Before that, he completed his PhD at the University of Wisconsin-Madison; his research there focused on a lot of different disciplines, including Vertebrate development and ecology. Like our other new hires, he will be serving as a research mentor in the 2021 BIT SURE program. His research will focus on applications of environmental DNA, or the DNA in a given environment. “I’d like to sit at this intersection of molecular biology and ecology,” he said. During his first semester, Dr. Hasley taught BIT 410/510 Manipulation of Recombinant DNA and co-taught BIT 402/502 Biotechnology Networking & Professional Development. He’s excited for the opportunity to mentor and work with students in a way rarely seen in a postdoc position, and to be able to implement the Universal Design for Learning practices he’s spent years teaching others about.
Like our other instructors this year, Dr. Arnab Sengupta had to adjust to teaching both lectures and labs online. This year, he taught BIT 410/510 Manipulation of Recombinant DNA, BIT 495/595 Special Topics in Biotechnology (RNA World and Genome Engineering and CRISPR Technology), and BIT 501 Ethical Issues in Biotechnology. He designed the coursework for RNA World himself, and he focused on building a supportive scaffold for students to work in. He also tried to build it around providing a good introduction to the most important parts of the RNA field: “We cover RNA fundamentals, including base pairing, and structure and function,” he said, “and we also cover the evolutionary concept of the RNA world hypothesis.” Because classes transitioned to being fully online early in the fall semester, his students focused entirely on data analysis while in lab.

2020-21 BIT T-Shirt

We make proteins
We are ribozymes
We are riboswitches
Not to mention, we carry the genetic code!
You might say, it’s an RNA World!

And try calling our non-coding cousins “junk” one more time...
I dare ya...
I double-helix dare ya!


Goller CC, Chen SH, Srougi MC. “New Tricks for Old Drugs: Using High-throughput Screening to Repurpose FDA-Approved Drugs to Combat Zika Virus.” National Center for Case Study Teaching in Science. Accepted July 2020/In press.


New Classes

Check out this link to see our Fall 2021 course offerings! We will offer a variety of topical modules, including an updated version of Plant Genetic Engineering, taught by Dr. Dums:

Plant genetic engineering has helped to revolutionize the way we study plants and produce plant products. The techniques involved have continued to change over time as we have progressed from engineering primarily model plants to more diverse non-model plants. However, all techniques can basically be boiled down to “How do I persuade this plant to do what I want?” In the Plant Genetic Engineering course, we will explore and discuss these persuasion techniques in the context of plant genetic genetic engineering, detection of transgene expression, and selection of mutant plants. We will look towards the future to discuss applications and ethics of emerging techniques. We will actively modify and optimize genetic engineering protocols and design hypotheses that can be tested using plant genetic engineering. My hope is that students will be able to approach any situation involving plant genetic engineering and have the skills to pursue forming and executing hypotheses.