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Application Summary

Competition Details

Competition Title:	2023 Innovation and Excellence in Laboratory Instruction Award
Category:	
Cycle:	
Submission Deadline:	02/12/2023 11:59 PM

Application Information

Submitted By:	Jacqueline Mohalley Snedeker
Application ID:	9843
Application Title:	Dr. Ben Galfond
Date Submitted:	02/12/2023 4:32 PM

Personal Details

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Primary School or Department
School of Chemical and Biomolecular Engineering

Primary Appointment Title:	Academic Professional

Application Details

Proposal Title
Dr. Ben Galfond

Nomination of Dr. Ben Galfond: CTL 2023 Innovation and Excellence in Laboratory Instruction Award

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Georgia Institute of Technology

February 5, 2023

CTL Innovation and Excellence in Laboratory Instruction Award

Dear Award Selection Committee:

It is my pleasure to nominate Dr. **Benjamin Galfond** for the CTL Innovation and Excellence in Laboratory Instruction Award. Dr. Galfond is an Academic Professional in the School of Chemical & Biomolecular Engineering. He is responsible for transforming our required undergraduate laboratory courses (ChBE 4200 and ChBE 4412) from among the lower rated courses in the curriculum to some of the courses most appreciated by the students. When he is instructor of record, Ben often receives scores of 5.0/5.0 on the "instructor is an effective teacher" questions in these courses (ChBE 4200: Su21; ChBE 4412: Fa19, Su20, Sp21) which is virtually unheard of in required STEM laboratory courses. Moreover, even when he is not the instructor of record, his day-to-day support in the lab enables colleagues to be effective instructors too. In addition to his transformative work in the required lab courses, Ben has played a pivotal role in embedding hands-on learning in ChBE lecture courses into the curriculum, including a design-and-build project in CHBE 2100 and take-home bucket experiments in several other courses (CHBE 3200 and CHBE 3210). When it comes to laboratory instruction, Ben's overall excellence and innovative contribution s to learning make him a strong candidate for this award.

In Spring 2020, when COVID descended like a cloud over campus, Ben was instrumental in our completion of the interrupted semester and our preparation for instruction in Summer 2020 and beyond. We teach a large number of laboratory sections in the summer, so we had to move quickly to plan and implement these courses in a modified format, given our health and safety constraints. The two laboratory courses that Ben leads are the only laboratory classes in ChBE's core curriculum, and as such, they are critical to the hands-on learning of our students, and central to our ABET accreditation (which was imminent at that time, Sp/Su 2020). As the central practical component of our curriculum, it was crucial to meet or exceed our stated student outcomes. Ben thoughtfully redesig ned the entire lab experience and augmented the course for distance learning. This redesign not only enabled effective instruction in 2020, but positioned the program for further laboratory innovations using hybrid teaching modes in future offerings.

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Ben used these tenets in redesigning the laboratory experience:
(i) the analytical rigor of the experiment cannot be diminished,
(ii) students must still understand and experience the practicalities of operation of complex laboratory equipment,
(iii) experimentation must be completed within scheduled class time,
(iv) students must have the opportunity to obtain unique, imperfect data to analyze and rationalize, and
(v) the redesigned approach had to be scalable and accessible to students with varying levels of internet connectivity and computing resources.
He then designed and deployed new courses that included remote lecture/lab hybrids, dynamic simulations, and at-home experiments. These approaches not only enabled a strong laboratory course experience under exceptional circumstances, but they also have provided new approaches that we have adopted and incorporated into these laboratory courses moving forward, even under conventional instruction conditions. For example, Ben learned from the hybrid lab experiences in CHBE 4412 that hybrid presentation of experiments provided students with more directed discussion time with the instructor during lab and better connections between theory and experiment , which enhanced student learning. **This innovation – real-time remote interaction with instructors —has been extended to lecture courses that previously had no laboratory component and thus no opportunity for real -time experimentation** . Students in a lecture hall can now watch live as a lab instructor follows the ir commands and a new dataset is generated to test their textbook's theories. Thus, Ben has exported new innovations from his laboratory courses to help other instructors in lectures without prior direct laboratory connections.

Ben also introduced the use of dynamic simulations, whereby students interact with an experiment through a computerized control panel, much as they would on the job in industry . The simulations deployed are true system models, with each data set dynamically generated based on student decisions. Since the simulations respond to student input, they do experiments as they see fit andexplore the system, testing their own understanding and building confidence and experience in drawing conclusions from tested hypotheses. Even after the return to in -person labs in 2021, these simulators have become a mainstay of our lab courses. However, they are not used as a replacement for in-person experiments , and instead serve as innovative learning supplements.

Ben has a gentle personality that encourages students to seek him out for help. In addition to the undergraduate students in the laboratory classes, Ben is highly sought after by the graduate students for assistance with LabView and other software that is used in both instructiona l and research labs. He is instrumental to the success of our school and is a critical member of our community. Each and every semester he is among the best scoring instructors in ChBE, and I

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expect he will be one of those teachers whom alumni seek out when they return to campus in 10-20 years. We are fortunate to have Ben as a member of our community. I believe he is an ideal candidate for recognition with the CTL Innovation and Excellence in Laboratory Instruction Award.

Sincerely,

Christopher W. Jones, Ph.D.
John F. Brock III School Chair and Professor
School of Chemical & Biomolecular Engineering
Georgia Institute of Technology

Experiential Learning and Innovation in ChBE Laboratory Courses

Coming from a rural public high school, I wasn't afforded a lab science class until I was an undergraduate student. The football coach who led my only biology course did well with the resources available. But when STEM topics stay in the textbook, few students will be excited, engaged, and prepared to apply what they learn to the world around them. At Georgia Tech, I have worked to give all students the opportunity to connect the theory they have learned with the reality around them. As an Academic Professional in the School of Chemical and Biomolecular Engineering, my core duties are to design, develop, and implement experiential learning opportunities. Along with additional instructional duties, such as teaching the Safety course (ChBE 4515), my main focus is on the instruction and daily operation of two senior-level laboratory courses – CHBE 4200/4210 (Unit Operations Lab) and CHBE 4412 (Process Control Lab). When I was hired, the lab curriculum and experiments had been largely unchanged for years, if not decades. At the time, the School was making a push to improve the lab experience and to also develop new hands-on modules for lecture courses. I immediately set to work updating equipment, procedures, and pedagogy to positive reviews from our faculty and students, as well as external advisors. My presentation in 2022 to our external advisory board regarding innovations to our laboratory instruction received uniformly positive feedback. Moreover, our lab instruction and facilities were singled out for praise in the report from our ABET committee based on our Fall 2020 accreditation review.

Funding and Implementation of Laboratory Initiatives

In my first year, I implemented previously-purchased equipment to both update old experiments and introduce new material. In Unit Operations, students tracked material transport and reaction kinetics in a Continuous Stirred-Tank Reactor (CSTR). The system at the time unfortunately required students to take manual records of the conductivity and temperature, an unwieldy proposition when high temporal-resolution measurements are needed for 20-minute test runs. I completely replaced our CSTR experiment with new equipment, and created a LabVIEW interface to display, record, and save experimental data. The same year in Process Control, I installed a cascade-control experiment, adding an entire new process that students had not previously been able to explore in lab. The instructional material and lab manuals I developed are still used by all course instructors and have significantly improved both the efficiency and the educational value of the experiments.

In later years, I have continued to explore all avenues to improve and expand our experimental offerings. The first experiment I developed in-house was the Fluidized Beds experiment for Unit Operations. With a limited surplus in departmental lab funding to spend, and limited physical space for a new experiment, I managed the design, machining, and construction of the physical units, and developed the experimental protocol and manual.

With this success, I then secured further funding for additional projects, primarily through the Tech Fee program. First, I used the funding to develop hardware and produce at-home experiment modules with our Associate Chair for Undergraduate Studies. After that, I took a leading role in the design and management of a new year-end project for our ChBE 2100 intro course (2019, $47,917). This has since become a premier component of the first Chemical Engineering course students take. For Unit Operations, I also led the bid for our Biodiesel Pilot

Plant (2021, $115,969) and developed all learning objectives and instructional materials. This experiment was pivotal for our lab as it shored up three weaknesses. First, it filled an important gap in the available bio-related experiments for our 4210 Bioprocess Unit Operations students. It also offered a new unit we did not previously have access to in liquid-liquid separation. Finally, it is only the second experiment we have that incorporates multiple unit operations in a single experiment – offering valuable insight into real-world chemical engineering.

Instructional Innovations

Assessment design

I find it crucial for instructors to always be conscious of their assessment modes and methods. The changes I've made in assessment mode and style have seen the most pronounced positive impact on student outcomes. One example that stands out is in the Process Control Lab. This course has traditionally relied upon TAs to provide feedback and grading on the writing style and efficacy of written reports. This system was inefficient and ineffective, as TAs would need to wade through lab reports that regularly exceeded 15 to 20 pages and were ill-equipped to provide constructive feedback on student writing. Because the other lab in our lab sequence, Unit Operations, is co-taught by an instructor trained in communication skills who helps students with their writing on longer reports, I decided to focus Process Control lab on a different form of communication. By changing the report format to a short, 2-page Executive Summary, TAs are now able to be trained on the communication points to look for and assess, providing more helpful feedback while taking less time to grade.

Evaluation: Students learn a new communication mode and have positively reviewed the format change, according to CIOS comments (see pp 5-6). I also modified report rubrics to design them around specification grading, giving clear guidance for students to improve.

Data-driven pedagogy

When re-evaluating assessments and other course material, I focus on ways to include practical, realistic, and hands-on components. For instance, our traditional pre-lab assessment consisted of a meeting with the TA, but it was logistically not practical and generally did not provide any noticeable differentiation in grades between prepared and unprepared groups. Students would frequently then come to lab unsure of what experiment they were to perform, much less how to accomplish the tasks ahead. To mitigate this issue and to decrease logistical challenges, I changed the pre-lab to a Job Safety Analysis (JSA, JHA), a common industrial tool, where students are forced to examine each step of the experiment and identify what must be done and if any safety hazards are to be expected.

Evaluation: Based on TA and instructor feedback, students are now more prepared when they enter lab, and students' technical scores increased by 7.47% ($p < 10^{-4}$) since instituting this approach.

Dynamic simulations

Initially created out of necessity during peak COVID semesters, I have found new ways to leverage the use of simulators for the instructional labs. These have been a natural fit in the ChBE field, as industrial-sized systems are rarely interacted with directly by hand but rather a

digital control panel. Exposure to SCADA-style interfaces provides students with the types of controls and indicators that would be present either in lab or at an industrial facility. The simulations are true system models, meaning that the system is not simply a video or scripted in any way, but that each data set is dynamically generated based on student decisions. Academic integrity concerns are ameliorated as students have their unique data. It also means that any errors by students are reflected in the same manner as if done in person, so students must be able to identify and correct any procedural problems based on how the experiment responds. Allowing for students to misstep and see the results was a core objective in developing the simulations, as these mistakes lead students to a better understanding of the system as they must apply theoretical knowledge to troubleshoot this "real" system. Since the simulations respond to any input, students are also able to intentionally go off-script and explore the system, testing their own understanding and building confidence and experience in drawing conclusions from tested hypotheses.

Evaluation: After our return to in-person labs in 2021, these simulators have become a mainstay of our lab courses, used by multiple instructors. They have allowed students to explore complementary experiments to further their understanding, perform replicate experimental runs that are not able to be fit in a single lab block, and examine systems in unsafe or otherwise undesirable configurations that they could not experience in-person. Notably, this innovation was not simply used as a replacement for in-person experiments. Instead, our School has continued to rely on them as an invaluable supplement that allows exploration and data generation previously impossible for our students, even in pre-COVID times.

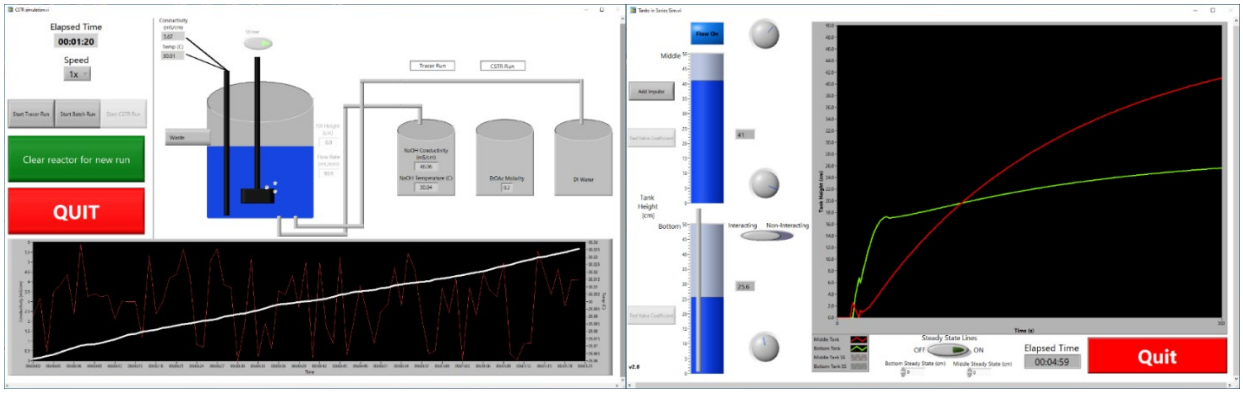

Figure 1 Example of new simulations generating unique data in response to student inputs.

At-home Process Control experimentation

One significant hurdle facing students in the Process Control Lab is their third experiment, when students transition from studying system dynamics to implementing controls. The two core concepts in this experiment are direct synthesis, where students design a controller based on system dynamics, and the subsequent fine-tuning of the controller parameters. When completed in the lab, students would have less than three hours to complete these objectives for the first time. This time crunch resulted in student stress, a rush for results without the option to refine analysis, and lack of time to explore the impacts of tuning controller parameters. To combt this issue, I used inexpensive commercially available hardware, an Arduino, to develop the

necessary software and modified experiment procedures so that students could complete the experiment at home.

When performed remotely, students have the time to fully evaluate and understand their decisions during direct synthesis, and then measure and experiment with fine-tuning approaches on a real system. Notably, further experiments that students must complete rely on understanding these two core concepts. Thus, when students can develop a better understanding during this remote experiment, they are under less stress and better able to achieve the learning objectives for the subsequent experiments that build upon this knowledge.

Evaluation: Three instructors have now used this experiment during in-person semesters to positive results – see CIOS scores and comments on the following page.

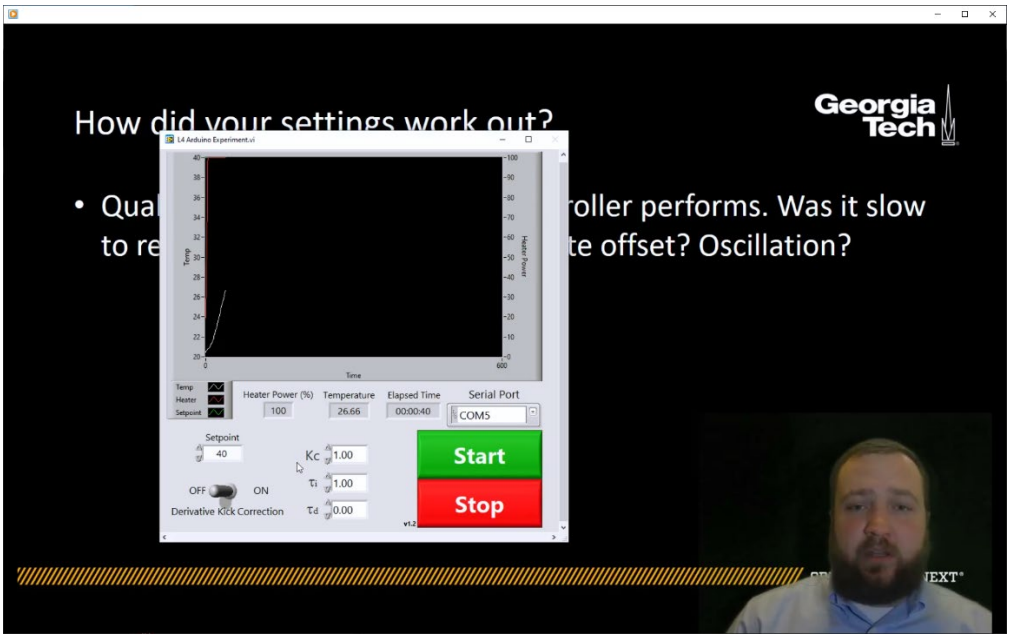

Figure 2 Screenshot of instructional video covering at-home, Arduino-based experiment.

The Arduino-based experiment was initially run on student's personal computers, though this resulted in an equity dilemma as some students were unable to complete the experiment without borrowing equipment from friends or coming in to the ChBE computer lab. Specifically, those students with Chromebooks, older Macs, or who relied on tablets were at a disadvantage. I was able to secure funding so that all kits include a Windows tablet with all software licensed and preinstalled.

Next steps: This innovation has opened further exciting opportunities for improvements to the curriculum. For instance, one key part of Process Control lab, and roughly one third of students' grades, is a project focusing on model analysis and control implementation; it was traditionally done in Matlab, which was worthwhile but limited in its scope. But starting this semester, students will instead be using a LabVIEW model of mixing tank to explore system dynamics and fine-tune a controller. They will also program a controller in LabVIEW – examining the minutia of how a control operates in a real system. Students must identify how

measurements are made, how that data is stored and used, what the physical limitations of the control mechanisms are, how the speed of the system electronics impacts control, and more. Once this is done, the students bring their programs into lab, and are able to connect to the actual physical system the model is based on. The code they wrote controls the physical system before them, and students must confront the challenges of applying their theoretical knowledge to an imperfect physical unit. I am very excited to see how students respond to this and if there is a measurable improvement to student outcomes.

Student survey results and selected comments

Student survey question:	Average Score (out of 5)	n
Communicated how to succeed	4.9	120
Respect for Students	4.9	120
Enthusiasm	4.9	120
Stimulates interest	4.8	120
Availability	4.9	119
Inclusive	5.0	120
Overall effectiveness	5.0	120

Course best aspect
(CHBE 4210) Dr. Galfond is an angel and is always willing to help students
(CHBE 4200) great feedback from professors and TA's, helped us improve on next assignment very available for consultation
(CHBE 4515) I really enjoyed the layout of the case studies and online modules. The additional videos and smaller activities added into the homework (specifically the CRW/video on how to use it) made the class connect to the real world for me better. I always appreciate when a class has problem solving sessions to go over applicable problems/through process of solving problems.
(CHBE 4515) Dr. Galfond is knowledgeable about the topic and gets into it; makes it exciting
(CHBE 4515) Dr. Galfond has a strong knowledge of safety processes, and this is clear in his teaching along with his zeal and care. HE is obviously invested in students succeeding and this shines through in everything he does.

Instructor greatest strength
(CHBE 4200) His care for his students. Actively discussed concepts with us during lab to ensure that we were learning to correct material.
(CHBE 4412) Incredibly passionate about the information. Always wanted to make sure that the students were succeeding and understood what was happening conceptually in each of the labs. One of the best and most caring professors I have had at GT
(CHBE 4515) Dr. Galfond is an incredible professor. One of his greatest strengths, in this class, was his ability to breakdown complex topics into simpler ideas, so anyone could understand it. This was incredibly helpful with this class, as it pulled from all other ChBE classes in the curriculum.

(CHBE 4210) Dr Galfond was never unavailable to help - even on the weekends! His help always leads students to the answer instead of straight telling them what to do
(CHBE 4200) I really enjoyed having Dr. Galfond this semester. He is very caring and made me interested in the material. He was always available to answer any questions and always explained all of his answers very clearly. He was also very clear with what it took to succeed in the course and would help anyone who struggled.
(CHBE 4412) This man was amazing. He tried to get me excited for the labs, checked in to make sure everything was going okay, and was overall just a great professor. He even let me come in to lab when I couldn't get my individual lab Arduino working and really helped me out! He truly cares about his students and it shows.
(CHBE 4515) The way that Dr. Galfond conducts his classroom shows a genuine care about his students learning as well as their actual wellbeing. He very clearly explains what is expected of us as students to do well in the class, and the material very closely follows any assessment given to us.

Future growth

One of my key goals is to contribute to curriculum development across my department, the Institute, and beyond. I currently manage hands-on projects for a sequence of three ChBE core courses, and intend to expand into new classes in future semesters. There is fantastic support from the other faculty in my department, and the funding through the Tech Fee program has repeatedly allowed us to create new modules to benefit our students.

Outside the department, I have repeatedly interfaced with other instructors as the ChBE representative on the COE Interactive Learning Task Force, and participated in Faculty Learning communities focused on lab instruction and classroom assessment.

Beyond Georgia Tech, I have published with a colleague on our work teaching the Unit Operations lab (Mohalley-Snedeker, J., & Galfond, B. (2022, August), *Expanding chemical engineering laboratory course design for next-generation engineers* https://peer.asee.org/41484). It is this work that I intend to directly expand upon this year. We found significant improvement in student outcomes related to writing and communications attributable to clear rubrics, feedback, and faculty interaction. I believe we can also modify the technical grading approach to better enable student improvement. Thanks to the support of my colleagues, I can continually refine and expand our laboratory offerings, and I look forward to making further innovations in the semesters to come that will expand the learning of our students.

Georgia Tech College of Engineering
School of Chemical and Biomolecular Engineering

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February 11, 2023

Dear CTL Laboratory Instruction Award Selection Committee:

I am writing this letter in strong support of the nomination of Dr. Benjamin (Ben) Galfond for the 2023 CTL Innovation and Excellence in Laboratory Instruction Award.

Ben joined the School of Chemical and Biomolecular Engineering (ChBE) at the Georgia Institute of Technology in 2016 in a technical supporting role for the educational labs and for research groups. Since then, he has shifted towards a more teaching-oriented role, currently as Academic Professional, and has played a pivotal role in the reorganization and streamlining of our educational labs. As Associate Chair, I interact with Ben frequently about the state of and plans for our ChBE instructional labs. Furthermore, I teach one of those lab courses myself occasionally (CHBE 4200/4210; Spring 2019 and Spring 2023) and rely on Ben's support for the take-home experiments and in-class demos in CHBE 3210, which I teach frequently. As a result, I have the privilege to observe Ben's interactions with and impact on our students on a regular basis. Based on those observation, I can assure you that he is highly deserving of this award. His impact on the quality of experiential learning of all ChBE students cannot be overstated.

Ben's primary role is ChBE is supporting the two mandatory senior labs, Unit Operations Lab (CHBE 4200/4210) and Process Control Lab (CHBE 4412), which are offered year-round (Summer, Fall and Spring). He is responsible for maintaining and upgrading the lab equipment, training and coordinating TAs, and developing and implementing new experiments. He serves as (co-)instructor of record for the two lab courses on a rotating basis with other faculty (incl. myself), typically having the full teaching responsibilities for a lab course each semester. In addition, Ben has become one of the key instructors for Chemical Process Safety (CHBE 4515) over the past years, which complements his role as Safety Officer in our School, and he usually leads one of the ChBE GT 1000 sections each Fall. As instructor in all of these courses, from first-semester freshmen to graduating seniors, Ben receives very favorable reviews from our students; they simply love him. He is extremely accessible to students and has strong commitment to their well-being without sacrificing academic expectations and standards.

Over the past years, Ben has been instrumental in our efforts to enhance hands-on experiences for our ChBE undergraduate students outside the senior labs. For example, we have introduced a "rig-building project" for students in our sophomore Chemical Process Principles lecture-based course (CHBE 2100). As part of the project, small

groups of students have to design, build and test a set-up with tanks, valves, pipes and pump that meets certain performance criteria. Ben helped submit the Tech Fee proposal for that innovation and takes care of the logistics for this course project every semester. He ensures that the course instructors do not have to worry about these significant practical aspects at all. Similarly, he coordinates the distribution and maintenance of "bucket experiments" in our junior Transport Phenomena courses. These initiatives have all been implemented as part of our standard curriculum and I don't know that we could have done that without Ben's support. Coordinating with a handful of faculty members each semester to integrate hands-on learning experiences in their lecture-based courses is no small task. Recently, Ben also led the acquisition of a biodiesel pilot plant for our educational lab through another Tech Fee proposal, and he has put together the lab manual for the experiment. This biodiesel pilot plant adds a key experience for our students with clear technical and societal relevance: turning waste frying oil into a fuel product.

Ben's knowledge and commitment to experiential learning is inspiring. And even though the pandemic is now mostly behind us, it provides excellent evidence as to why Ben should receive this award. When the pandemic forced us to pivot towards remote learning for our Summer 2020 lab courses on very short notice, he essentially single-handedly ensured that everything was ready when the semester started mid-May. He coordinated and implemented a clever, balanced combination of at-home experiments with kits that were sent to students' homes, simulations of lab set-ups, and remote experiments with a TA executing instructions from students via Zoom. Although I would not dare to claim that the lab learning experience in Summer 2020 was the same as pre-pandemic, it was a remarkably positive and successful learning experience for students. And many of the lessons that were learned in 2020 have since been used to improve the in-person lab experience.

Honestly, I cannot think of anyone more qualified to receive the CTL Innovation and Excellence in Laboratory Instruction Award and as a former awardee myself I have to say that I believe that Ben in 2023 is more deserving than I was in 2018. I realize that there will be other strong candidates from the campus community and that the committee has a difficult task, but I urge you to give Ben your full consideration.

If you have any additional questions, please do not hesitate to contact me.

Sincerely,

Dr. Victor Breedveld
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(404) 313 2155 (cell)

Yonathan S. Thio
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January 31, 2023

To the award selection committee,

I am writing to give my strongest recommendation for Dr. Benjamin Galfond for the Innovation and Excellence in Laboratory Instruction Award. Dr. Galfond joined our School in 2016 as a Laboratory & Facilities Coordinator. Since then, he joined the faculty and is currently an Academic Professional. In addition to his primary duties of teaching lab courses and managing the undergraduate teaching labs, he also works with other faculty members in developing experiments for classrooms and in research labs. In all these aspects, he has made many invaluable contributions to the learning experience of students and to the School.

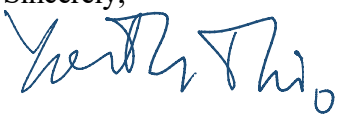
Since he joined our School a few years ago, Dr. Galfond has made many innovations in the teaching labs that both enhance the quality of learning and improve the quality of life of students. For example, Dr. Galfond created a series of introductory videos for experiments in our Unit Operations lab. These short videos have made it easier for students to prepare for the experiments, and they complement the lab manuals by giving visual directions to students during the experiments. He also introduced to the labs the use of Job Safety Analysis, a practice that not only raises students' awareness of safety hazards and precautions associated with the labs, but also instills the habit of taking workplace safety seriously. Through these innovations and other smaller but not less significant changes in the last few years, Dr. Galfond has developed a more streamlined and thoughtful process for the training of students and TAs that emphasizes learning, efficiency, and safety.

Other major innovations by Dr. Galfond in the teaching labs are the development of remote labs and simulations. These experiments were born out of necessity for remote instructions in 2020 and 2021, but they have continued to serve the students well even now when labs are done in-person. In the remote labs, Dr. Galfond uses cameras to broadcast a TA performing an experiment following requests and instructions from students attending online. Students who cannot attend in-person can still see the immediate effects of changing certain settings or experimental parameters, and can discuss the experiments with the TA or among themselves. Dr. Galfond also developed several high-quality simulations that students can run on their own computers. The simulations replicate the measurements in the lab, down to noise and fluctuations typically seen during the experiments. While students performing the simulations do not have the hands-on experience, they have the advantage of being able to investigate extreme experimental conditions, even ones that cannot be achieved in the real experiments. Many of these innovations also continue to serve as inspiration for lasting curricular improvement in the lab courses, both in content and in modes of instruction.

Dr. Galfond has excellent rapport with the students in the labs, helping to run and troubleshoot the experiments as well as talking with them about the concepts behind them. In my own observation of Dr. Galfond's interaction with the students, I find him to have the right balance between being approachable and helpful and being the authority in the labs with high standards on safety and technical excellence. He listens to students' questions and concerns, and often gives hints and suggestions that make the students think and find the answers themselves.

For all these reasons, I consider Dr. Galfond an instructor who best demonstrates Innovation and Excellence in Laboratory Instruction, and thus deserves the Award. I am confident that he will continue to make significant contributions to our School's laboratory instructions and to the Georgia Tech community.

Sincerely,



Yonathan Thio

Senior Lecturer

School of Chemical & Biomolecular Engineering

Dear Committee members:

My name is Nichole Beck, an undergraduate student in the School of Chemical and Biomolecular Engineering, and I am writing to you with great enthusiasm to recommend Dr. Benjamin Galfond for the 2023 CTL Innovation and Excellence in Laboratory Instruction Award. I have had the privilege of taking CHBE 4210 Unit Operations Lab (Summer 2022), CHBE 4515 Chemical Safety Processes (Summer 2022), and CHBE 4412 Process Control Lab (Spring 2023) under Dr. Galfond's tutelage, as well as having the honor of being his undergraduate course assistant for CHBE 4515 in the Fall of 2022. Dr. Galfond has been an inspiration to me in my final year at Georgia Tech, in not only the way he demonstrates course content, but in how he truly cares for the education and wellbeing of his students and TAs.

Though the repertoire of courses mentioned above seems broad, he has been able to bring excellence and innovation to every course. In CHBE 4210 and 4412, there is a higher demand of work for CHBE students in not just performing our labs, but in the data analysis required of them. Dr. Galfond goes above and beyond to make sure that we are not just going through the motions of completing an assignment to turn in, but that we truly understand the data in front of us and how it applies to the real world. One of the best ways he does this is through developing exercises and pre-lab videos for these courses. As I have just started CHBE 4412, I can speak more to how he applies these tools in CHBE 4210.

In the summer semester of 2022, my lab partner and I were the only two biotechnology students taking Unit Operations Lab. Because of this, I was worried I wouldn't get to dive into the biotech-focused experiments and would be given majority standard option ones instead. Within the first week of class, Dr. Galfond made clear that we would be given the same opportunity as students in other semesters and that would not change just because there was only one biotech group. He made a strong effort to make sure we had pre-lab videos explaining every lab, even though we were the only two students performing some of these experiments. These videos included step by step procedural instructions explaining the use of the required instruments, and how to maintain proper safety while using them. They are a great help and add a much needed audio and visual aid to accompany the language of the traditional lab manual.

In addition to this assistance in preparing us for experiments, Dr. Galfond also applies much time and thought to explaining how to properly analyze experimental data. Before our first take-home lab, Dr. Galfond led the class in an interactive data analysis exercise, where we all participated in individual excel sheets and learned how to analyze data and determine best model fits. While this task may at first glance seem unnecessary for 4th year students, it allowed us to have a real guided lesson in sorting through experimental data for the first time. Dr. Galfond shows much care in making sure we have all the tools to succeed, instead of assuming we already have them. He also shows the same care in his office hours, where my partner and I spent much of our summer. He always makes time for his students' education, no matter how small the question.

When transitioning from his student to his course assistant, my respect for his efforts only grew. Although CHBE 4515 is only a 1 credit hour course, Dr. Galfond makes sure every student leaves the class with the knowledge to make ethical and safe choices in the workplace. He provides problem solving videos to help students with their homework and to have an aid at home, as well as uses real world case studies that lead to full class discussions on proper safety as a chemical engineer. These lessons teach us how to not only protect ourselves, but how to protect our future fellow employees, and the community. I truly believe he is making the world of chemical engineering safer by putting a real

effort into this course. As his course assistant, we would have weekly meetings where we would discuss students' achievements and difficulties to make sure they were properly understanding the material taught and showing this understanding in their assignments. During these meetings he would also check in with the course assistants to make sure we were not overwhelmed with work, and would gladly receive any kind of feedback we had for him to make the course better.

I believe Dr. Galfond is a strong candidate for this award and absolutely exemplifies innovation and excellence at Georgia Tech. His commitment to his students is blatantly obvious and deserves to be rewarded. Dr. Galfond is the reason I was able to become a course assistant and decided to pursue graduate programs focusing on biotechnology and safety. I am so grateful for his continued instruction and support as a student at this school, and know many others feel the same.

I fully endorse Dr. Benjamin Galfond for the 2023 CTL Innovation and Excellence in Laboratory Instruction Award. Please let me know if I can be of any further assistance to the committee.

Best,

Nichole Susanne Beck

School of Chemical and Biomolecular Engineering

Class of 2023

Dear CTL Awards Committee,

I am Diana Oh, a fourth year undergraduate Chemical and Biomolecular Engineering student, and I am delighted to write this letter in support of Dr. Galfond's nomination for the CTL Innovation and Excellence Award in Laboratory Instruction. In the last two years, I have had the pleasure of taking three classes under Dr. Galfond's instruction, including two labs: Unit Operations Lab and Process Controls Lab. His teachings translated textbook topics into hands-on experiments, furthering my understanding of the concepts and exposing me to real world applications. Furthermore, beyond strengthening my conceptual understanding, his instruction helped me adjust to the laboratory setting. Specifically, his pre-lab videos helped me gain a sense of confidence in laboratory, allowing me to learn in an unfamiliar environment comfortably and safely. Additionally, his take-home experiments provided the opportunity to learn interactively beyond the lab.

In starting the Unit Operations Lab, I was undeniable nervous. While I had taken labs for general science courses, this class was my first chemical engineering lab, and the lab was "Glucose-Fructose Isomerization." Opening the lab manual brought me no comfort, instead it intimidated me with all the esoteric material names, such as the "D-xylose ketolisomerase". However, leading up to the lab, I was assigned to watch a prelab video, in which Dr. Galfond demonstrated running the packed bed reactor, elaborated the procedures, and highlighted main safety concerns. Even before setting foot in the lab, I felt more confident and safer because I had visuals to match the written procedures. I was able to better conduct the experiments, as I was now familiar with the equipment and procedures, despite never seeing them in-person. These pre-lab videos were available for each lab in both Unit Operations and Process Controls lab. From explaining how to control a CSTR to identifying hot elements on the equipment, his pre-lab videos made my lab experience safer and more approachable.

Beyond providing resources to support in-person labs, Dr. Galfond also developed take-home experiments, such as the Gummy Bear lab for the Unit Operations, which facilitated learning lab practices beyond the classroom. As teams, we were tasked to tracking the growth of a gummy bear's size over time as it was submerged in different solutions. While the problem seemed out of the scope of chemical engineering, it proved to be complex than expected. His experiment pushed my groupmates and I to apply our knowledge of diffusion and osmosis to understand the behavior of an everyday object. Dr. Galfond highlighted the prevalence of engineering in real world by asking us to extrapolate the diffusion in the gummy bear to real world tools such as membranes. The lab also provided the opportunity to be creative, forcing us to find use everyday objects like spoons, baking trays, and glasses as our lab equipment. This element of creativity pushed our problem solving ability and understanding of good lab practices, since we balanced the availability of materials with maintaining consistent measurements. Additionally, he promoted teamwork and collaborative learning, which ultimately helped me navigate working in a research lab where I collaborate and share work with other researchers and students.

Dr. Galfond not only puts his time and effort into teaching chemical engineering concepts in the lab, but also provides the tools to grow as a scientist in the lab. His passion for teaching and lab instruction inspired me to love and feel at home in the lab. Through giving feedback at office hours to making extra videos explaining challenging concepts, he engages with and supports his students in mastering and applying the learned material. His pre-lab videos and take-home experiments highlight his willingness to foster his student's intellectual growth and their comfort in lab settings. With this in mind, I believe that Dr. Galfond has exhibited he is deserving of the CTL Laboratory Instruction Award.

Sincerely,

Diana Oh

Dear CTL Awards Committee,

It is my immense pleasure to support the nomination of Dr. Benjamin Galfond for the Innovation and Excellence in Laboratory Instruction Award. I am an undergraduate student in the School of Chemical and Biomolecular Engineering and have had the honor of having Dr. Galfond as a professor throughout my entire collegiate career, starting in GT1000 through the final two labs I have taken at Georgia Tech: Unit Operations and Process Control Lab.

My first meaningful interaction with a professor at Georgia Tech occurred a couple of weeks into my first year when Dr. Galfond, one of my GT1000 instructors, spotted me walking by the CULC and stopped to give feedback on my resume. I realized how important students are to him, as he would go out of his way to talk with someone he barely knew just to see how they were adjusting to campus. His passion to help students was immediately obvious as he remembered a single student's resume out of an entire class. This pattern of care for students' learning and well-being has been evident throughout every interaction I have had with Dr. Galfond over the last four years.

In the Summer of 2021, I took Chemical Process Safety with Dr. Galfond as a hybrid course. It was clear throughout the course that Dr. Galfond was not going through a list of topics simply to cover them but was taking the time to ensure students had a fundamental understanding of each topic. He designed instructional videos covering each topic with in-depth explanations that allowed students to review the topics as often as needed. He would then use the in-person time to focus on interesting applications of the instructional videos, using various media to appeal to a variety of learning styles. Dr. Galfond presented a range of real-world incidents that drove home the importance of each specific topic. His teaching style and engagement with students make him an extremely effective instructor whose teachings have had a direct, positive impact on students as they start work in industry.

The only thing more impressive than Dr. Galfond's teaching ability is his effectiveness as a lab instructor. While the pandemic affected many aspects of learning, labs—where hands on learning is essential—were particularly impacted. The first lab I took with Dr. Galfond was Process Controls (PC) Lab in a hybrid format. Like the videos from Process Safety, it was evident that Dr. Galfond put substantial effort into creating comprehensive simulations to replicate labs that we were unable to do in-person. He took advantage of the situation and designed simulations where students could see long term trends in the data that would not have been possible to obtain in a standard lab period. The simulations were easy to use and mimicked the in-person experiments extremely effectively to the extent that I felt no drop off in learning between the two experiment modes. In fact, my team often found that we gained more out of the simulations, specifically due to the added features Dr. Galfond took the time to include (longer time scales, experimental noise, completely visual representations, etc.). Despite being the lab instructor and not the process controls instructor, Dr. Galfond went out of his way to help students understand the theory behind process control regardless of whether it was in relation to the lab or the course.

As I moved into Unit Operations Lab, I saw Dr. Galfond's work in a different lab setting. During each lab, he ensured that every group had a clear understanding of the lab and

would point students in the right direction so that lab reports could be focused on analyzing data and finding theoretical explanations instead of error identification and explaining process missteps. Due to Dr. Galfond's prioritization of students' learning in Unit Operations Lab, I was able to gain more practical and application-based knowledge in this lab than in any of my prior classes at Georgia Tech. No matter the question, Dr. Galfond provided timely responses that put students on a path towards understanding and giving them the tools to arrive at answers without explicitly answering the questions himself. Coupled with his knowledge of theory and each specific lab, he was able to make Unit Operations lab a true learning experience without the frustration that can often come with performing experiments.

Dr. Galfond is a beloved member of the CHBE department and is adored by many students. It is evident that he cares about students and will do all he can to facilitate learning regardless of what challenges he faces. His care goes far beyond the classroom, and I can easily say he has made my time in his classes and labs the most instructional and entertaining of any at Georgia Tech while still prioritizing all students' health. As I returned from my internship, there was no doubt that my experience with Dr. Galfond in Unit Operations lab and Process Safety had the greatest impact on my development as an engineer and I am not alone in that belief. I have yet to find another instructor more deserving of the Innovation and Excellence in Laboratory Instruction Award than Dr. Galfond.

Sincerely,

Siddarth Seemakurti
B.S. Candidate in Chemical and Biomolecular Engineering
Georgia Institute of Technology

To the Selection Committee,

It is with great enthusiasm that I write this letter in support of the nomination of Dr. Ben Galfond for the Innovation and Excellence in Laboratory Instruction Award. As an undergraduate student in Chemical and Biomolecular Engineering, I have had the privilege of taking both CHBE 4210 (Bioprocess Unit Ops Lab) and CHBE 4412 (Process Control Lab) with Dr. Galfond. His innovative and engaging lab sessions have left a lasting impression on me and many of his other students. Of the many highly qualified and esteemed faculty at our institution, I can think of none more deserving of this award than Dr. Galfond.

One of the innovative strategies Dr. Galfond implemented into his teaching was the development of pre-lab videos. Before each laboratory session, he would create a short video that students could use to familiarize themselves with the apparatuses and procedures ahead of time. This was an incredibly helpful resource for students as it allowed us to come to the lab with a solid understanding of what we were supposed to do. These videos greatly facilitated the lab experience by enabling us to focus on the hands-on aspects of the lab, rather than spending time asking questions about procedures or concepts.

Another hallmark of Dr. Galfond's innovative teaching style was the use of simulations and take-home experiments. His interactive simulations enabled students to explore complex concepts from the safety and comfort of their own homes, without the need for any expensive equipment. These simulations allowed us to apply what we learned in the classroom to real world problems, providing us the opportunity to demonstrate our understanding of the material in a more comprehensive way.

In addition to his innovative laboratory sessions, pre-lab videos, simulations, and take-home labs, I would also like to emphasize the breadth of Dr. Galfond's knowledge and teaching ability that makes him such an excellent instructor. The lab courses he was responsible for teaching require a sound understanding of the fundamentals of thermodynamics, transport phenomena, separation principles, and kinetics. Dr. Galfond played an integral role in helping many of us make the connections between these concepts to see how information from all of our previous courses fit together into a larger framework. Learning to think critically and analytically while synthesizing the combined knowledge from my previous classes has honed my skills both as a student and as an engineer, and it was only made possible through the impressive tutelage of Dr. Galfond.

Finally, I would like to highlight Dr. Galfond's success as an educator in creating a collaborative and creative learning environment. He recognizes the importance of group dynamics in the learning process and encourages students to communicate with each other, challenging each other in a respectful and constructive manner to promote deeper learning. His use of guiding questions to facilitate discussions was particularly effective in engaging students as active participants in the learning process.

Dr. Galfond is a dedicated and talented educator who brings a unique combination of creativity, expertise, and passion to the classroom. Between his innovative teaching initiatives and his excellence as an instructor, I firmly believe that he is the most deserving recipient of this award, and I encourage the committee to give his application the consideration it deserves.

Sincerely,

Jack Langan

Miss Hannah Huang
hhuang358@gatech.edu

January 30th, 2023

Dear CTL Awards Committee,

I am writing to enthusiastically support Dr. Galfond's nomination for the 2023 Innovation and Excellence in Laboratory Instruction award. Dr. Galfond was my instructor for both Process Control lab and Unit Operations, two senior-level Chemical and Biomolecular Engineering labs. Dr. Galfond consistently demonstrates his passion for helping students master material and improve their technical communication skills while fostering respect and professionalism.

After a year of virtual and hybrid learning, both students and professors were excited to perform lab experiments in-person. Dr. Galfond rearranged equipment and scheduled labs so each group could safely gain hands-on experience. He took the time to made demonstration videos for each lab, emphasizing safety and best practices. To increase flexibility, Dr. Galfond also incorporated virtual labs with realistic, built-in uncertainty. Working with process control software and virtual simulations was invaluable experience as these technologies are integral to modern research and manufacturing facilities. Regardless of the nature of the lab, Dr. Galfond challenged us to gain conceptual understanding rooted in fundamentals.

While performing simulations and experiments, Dr. Galfond was always willing to answer our questions. Rather than immediately explaining observed behavior, he asked us to draw upon prior knowledge and build upon fundamentals from previous courses. My lab mates and I learned in an environment where we were empowered engineers making decisions, controlling systems, and reporting our findings. Dr. Galfond's professional guidance equipped us to think critically and communicate under pressure in practical situations. This prepared us for individual and group presentations where we discussed our findings from the lab and took questions from the audience.

Dr. Galfond understands that learning takes place both in and out of the lab; therefore, he makes himself widely available for consultation throughout the week. In addition to answering questions that arise during lecture and experiments, he is happy to meet with groups virtually and in-person to discuss experimental results and questions. He also regularly provides feedback and guidance on Piazza, an online forum for students to collaborate and ask questions about lab procedures and results. Dr. Galfond's flexibility, approachability, and adaptability to multiple communication and learning styles not only evidences his commitment to students, but makes him one of the most effectives instructors I have been privileged to have.

My classmates and I greatly appreciate Dr. Galfond going above and beyond to support our learning. Thanks to his excellent instruction, we are better equipped to become well-rounded and critically-thinking engineers. It is an honor to fully support his nomination for this award.

Sincerely,
Hannah Huang