



## Backstory

# Project symphony: Composing a masterpiece in a science laboratory

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In the spirit of collaborative science, Prof. Sunghee Lee (Chemistry Professor at Iona University in New York, USA) embarked on her academic career with a vision to bring an interdisciplinary approach to undergraduate education. At a Predominantly Undergraduate Institution (PUI) such as Iona, she saw a unique opportunity to weave together teaching and research, creating a rich tapestry of learning experiences for students. Her goal was simple yet ambitious: to use research as a bridge connecting classroom theory to real-world interdisciplinary scientific practice.

In this Backstory, Sunghee and her students and recent graduates reflect on the development and experiences that shaped their journey through *Project Symphony* and the resulting skills they've learned. The symphony they've created together is a testament to the transformative power of collaborative undergraduate research – a melody of discovery that continues to evolve and inspire.

**Above image: Former *Project Symphony* members joined at the first Reunion in Oct. 2022. As we look back on the two decades of *Project Symphony*, it reminds us how the whole is greater than the sum of its parts. Collectively we managed to achieve something that seemed “impossible” at first, all because we work together as a harmonious group**



## The prelude to project symphony

### Sunghee

In the world of science, solving complex problems is rarely a solo adventure. Imagine trying to complete a massive, intricate puzzle where each piece represents a different scientific discipline - biology, chemistry, physics, engineering - and only by carefully fitting them together can we see the full picture.

During our academic journey - from undergraduate labs to graduate research and postdoctoral studies - we're often trained to dive deep into our specific domains. We become experts in our narrow lanes, mastering techniques and understanding nuanced details. But here's the catch: real-world challenges don't respect disciplinary boundaries.

Think about the grand challenges we face as global citizens: developing sustainable technologies, combating climate change, or creating breakthrough medical treatments. These aren't puzzles that can be solved by a single scientist working in isolation. They require a collaborative symphony of diverse expertise, where each researcher brings a unique perspective and skill set.

As someone who has navigated these scientific landscapes, I've learned that our strength lies not in our individual brilliance, but in our ability to connect, communicate, and co-create across traditional academic borders. Interdisciplinary collaboration isn't just a buzzword, it's the key to unlocking innovative solutions that can truly make a difference.

I firmly believe that students learn best from active scientists - the passion we have for our work naturally spills over into our teaching, igniting curiosity and enthusiasm in our students.

When I started, my "lab" was modest - just one microscope on a bench and a single desk for a student. It was a humble beginning, but it was a start. Fast forward nearly two decades and the transformation is remarkable. Today, I oversee a well-equipped research laboratory bustling with activity. It's home to an impressive array of instruments and, more importantly, to over a dozen undergraduates actively engaged in research at any given time.

This growth isn't just about equipment or numbers; it's about creating an environment where students can experience the thrill of scientific discovery firsthand. They're not just learning about interdisciplinary collaboration - they're living it, working on projects that span multiple fields and learning to communicate across disciplinary lines.

In this vibrant setting, students aren't just preparing for future careers; they're already participating in the scientific community, contributing to knowledge creation, and developing the skills they'll need to tackle the complex challenges of tomorrow. It's a testament to the power of integrating teaching and research, and to the incredible potential of undergraduate students when given the right opportunities.

Our research group is called "*Project Symphony*," which came from a vision in which all research group members work together in harmony to achieve shared goals, while maintaining individual interests with the support of each other, analogous to the orchestration of a musical symphony. As in a symphonic orchestra where musicians play a variety of instruments, our research group assembles a collection of minds from different disciplines who are encouraged to approach a problem from multiple perspectives in a supportive environment.

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### Key notes of the *project symphony* pedagogical framework

One of the unique aspects of the *Project Symphony* is that the research team is entirely composed of undergraduate students. There are no graduate students and no postdocs. Undergraduate students are actively involved in all phases of research activities and are co-authors of all published articles. They are engaged during the design and execution of experiments and learn how to operate, maintain, and troubleshoot each instrument they are regularly using. They analyze the data and interpret the results and come up with the follow up experimental design and plan forward. Over the course of their multi-year-long involvement in *Project Symphony*, they experience the scientific research process and also learn how to deliver their findings, through the presentation of their works in refereed journals and presentations at conferences. So, from start to finish, every undergraduate in the *Project Symphony* has an opportunity to live through the experience the science making and appreciate the fruits of hard work when it finally becomes publicly available.

Running such a laboratory with only undergraduate students, especially when more than a dozen students are involved, could be challenging but it is rewarding. The training typically involves working one-on-one in close collaboration with the PI and with their peers in a supportive environment throughout the semester and summer. An overview of the process is summarized in Image 2, and a more detailed framework is included in our previous publication.<sup>1</sup>

### The role of interdisciplinary collaboration in orchestrating success

One unique part of the *Project Symphony* is the aspect of 'collaboration' while individually performing their parts. Many undergraduate students have research opportunities; however, I believe the large majority of students are involved in an individually focused research experience, and exposure to teamwork is not necessarily a part of their research training. While each individual student is responsible for doing certain scientific experiments, in *Project Symphony*, a student quickly realizes that with the coordinated and collaborative effort in every research stage, an individual effort can amplify to a greater than the simple sum of their own contributions, both in scientific findings and understanding the bigger problems.

Another unique aspect of the *Project Symphony* is the interdisciplinary nature of the project which is ideally suited for students to collaborate regardless of their specific interests or disciplines. The main research theme of the *Project Symphony* is on the understanding of the cell membrane and its interactions with bioactive molecules through the multi-disciplinary lenses at the intersection of biology, physics, chemistry, mathematics, and computer science. As such, our group members come from diverse disciplines, from computer science to physics to chemistry to biology majors who are interested in computational, theoretical, and experimental approaches yet working collaboratively as a single cohesive group toward the main research goal. Interdisciplinary research projects facilitate cross communication between individual projects, mimicking a symphony that consists of multiple distinct sections. This experience provides opportunities for students to integrate knowledge across disciplinary boundaries. This experience enhances a broad view of scientific research and eventually trains them to be able to address complex challenges once they graduate.

### Conductor's reflections

#### Challenges and successes

*Sunghee.* The most difficult challenges are related to building a positive mindset in each student. Failures from an experiment, challenging experimental procedures, and unexpected results are all inevitable in science research. How to deal with such

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setbacks and frustration are something that is not so readily explainable in words alone. As a faculty leading a large number of undergraduate students, I need to step into students' situations frequently and see what can be helpful when they experience pessimism and stress. How can it be made more digestible but meaningful, so that each one will feel satisfaction and a sense of accomplishment? How can they be continuously encouraged and recover from disappointment from the research process? Each student will respond differently, so getting to know each student helps to come up with different scenarios for different situations. This is certainly a challenge when a group is as large as we currently have.

However, the benefits definitely outweigh the occasional challenges. Over nearly two decades, almost 90 former *Project Symphony* members who have graduated are now working in society as proud and productive members, whether as a PhD, MD, and other health/law professionals, science teachers, and industry scientists. In fact, in October 2022, we had our first *Project Symphony* reunion on campus and rekindled our bonds many years after their graduation. Each one of them shared what it meant for them as a part of *Project Symphony* member and how it propelled their chosen careers. Many of them remained in contact with each other and truly showed a large extended family. That is the greatest benefit of *Project Symphony*!

Looking back on my experience guiding students through scientific research, I've observed a diverse range of career paths among my former research group members. Roughly a third have pursued advanced science degrees, another third have obtained professional or technical degrees (both in science and other fields), and the remaining third have immersed themselves in full-time positions across various industry sectors, including education.

The evolving nature of scientific research is reflected in our group's theme: "understanding the cell membrane and its intricacy with other surrounding molecules." Within this framework, we've adapted to changing circumstances and embraced new ideas.

Student-initiated projects often address practical problems, steering our research toward more applied directions. These projects tend to garner enthusiastic dedication from the students involved. Additionally, collaborations with researchers at other institutions have expanded our research portfolio into challenging new areas.

In summary, working with students over two decades has positively transformed our research in remarkable ways. It's a mutually beneficial relationship where students bring fresh perspectives, challenge established paradigms, and trigger the exploration of new areas. Combined with technological advancements, this collaborative approach keeps our scientific endeavors dynamic and energizing.

### Student reflections

#### **Question #1: How has your involvement with Project Symphony influenced your understanding of the research process and your approach to conducting research?**

*Marnie Skinner (class of 2020).* Maybe the most important thing my research experience did was prepare me for failure quickly. There is a lot more troubleshooting or problem solving that goes into working in a research lab as opposed to a lab for class. This was my first experience in a research lab setting, and it served as a good example of how to keep progressing despite failed experiments or unexpected results.

*Jasmin Ceja-Vega (class of 2023).* My involvement with *Project Symphony* profoundly influenced my understanding of the research process and changed my approach to conducting research. One key understanding was how important planning and organization is needed for an experiment. The preparation for the experiment is equally important as the experiment. Paying attention to detail and double-checking help prevent the experiment from going wrong. Also, some experiments didn't go as planned, which felt discouraging. I learned that setbacks are part of the research process. Even if the experiment goes as wanted, information can be learned. Therefore, the methods can be revised and the hypothesis can be changed. I now approach challenges with a more flexible mindset and understand that research often requires continuous adaptation and improvement.

*Micaela Panella (class of 2025).* My involvement with *Project Symphony* was my first experience conducting research. Working in the *Project Symphony* Lab has provided me with the confidence and

problem-solving skills necessary to continue research. The research process is not about always getting the right results from the first attempt but also about learning from mistakes and the outcomes of experiments to enhance your understanding of the system you are working with. The *Project Symphony* Lab has many members working on the same drug-lipid system using different instruments, allowing for collaboration with peers who may have a different perspective on the system at hand. Whether cultivating new systems to experiment with or designing a new method to a system, *Project Symphony* has allowed me to expand my knowledge and critical thinking skills in a way that my undergraduate courses have not.

*Elizabeth Andersen (class of 2026)*. So much of the research is built from trial and error, educated guesses, and discussion amongst peers. Before I was involved with *Project Symphony*, I had not considered, nor truly understood, the importance of communication and sharing ideas with peers. The *Project Symphony* has several teams focused on different biophysical properties of model cell membranes, and yet I have collaborated with peers on DSC, water permeability, and IR to adapt techniques, solve issues, and breakdown calculations. I have shared data, comparing results to understand the larger picture and determine if the data across teams coincides or if the results conflict, and if so, review the process once more to determine if there were sources of error.

*Jessica Said (class of 2026)*. Joining *Project Symphony* has transformed my understanding of research, it is more than just following a predetermined protocol; it is a dynamic process that combines creativity, critical thinking, and problem-solving. Through my experience at *Project Symphony*, I learned the importance of precision and attention to detail in producing reproducible and reliable results. This has also fostered a mindset of resilience and adaptability, recognizing that unexpected results or setbacks are not failures but opportunities to refine my methods and reevaluate my approaches to my experiments. *Project Symphony* has taught me to view challenges from multiple perspectives and embrace them as essential components of the research process.

**Question #2: What are your career aspirations, and how do you anticipate that your experience with Project Symphony will impact or shape your future professional goals?**

*Marnie Skinner (class of 2020)*. Since graduating from Iona College and leaving *Project Symphony*, I began pursuing my doctoral degree in Biochemistry and Molecular Biology at Johns Hopkins University. The lab I currently work in assesses mechanisms related to genomic integrity and specializes in reproductive assessment techniques. From this experience, I hope to continue after my PhD in the field of reproductive health. *Project Symphony* instilled a good researcher mindset in me that has made progressing through my PhD career easier. Skillsets such as critical thinking are important for moving forward successfully in graduate school, and *Project Symphony* helped me establish those skillsets early.

*Jamie Gudyka (class of 2024)*. Since graduation, I have taken a position at the National Cancer Institute (NCI) at the National Institutes of Health (NIH) as a postbaccalaureate research fellow. Here, I am doing research in the chondrosarcoma field within the pediatric oncology branch of NCI. After this two-year position, it is my goal to then pursue an MD/PhD degree. If it were not for my involvement in *Project Symphony*, I would not have the passion to pursue this academic endeavor. *Project Symphony* gave me the opportunity to go to conferences such as the American Chemical Society and listen to research talks and present my own research findings. Being immersed in the field opened my eyes to the different fields of research that were being conducted. Having these opportunities allowed me to make connections with programs and learn about different career aspirations. Between having my own project in *Project Symphony* and being exposed to the different fields of research, it sparked my interest to pursue a degree in research and continue to explore new problems and techniques that can hopefully one day help people whether that be through medicine or different techniques.

*Jasmin Ceja-Vega (class of 2023)*. My career aspiration is to become a clinical pharmacist with the goal of bridging the gap between research and patient care. Being part of *Project Symphony*, a research group dedicated to creating artificial mimics of cell membranes and studying drug membrane interactions, has provided me with research experience that influenced my path to pharmacy school. During my four years of undergraduate research, I had the opportunity to study the effects of various phytochemicals on model cell membranes and work on the publications of this research. This fueled my interest in pharmaceutical research and helped me determine that I desired a Doctor of Pharmacy degree. The skills I developed while working on *Project Symphony* have been crucial in shaping my professional journey. From honing my ability in critical thinking, communication, data analysis, time management, and organization, I feel that I am well equipped to enter pharmacy school with a research driven mindset.

*Caroline Scott (class of 2025).* It was during my time with *Project Symphony* that I realized I wanted to pursue a PhD and dedicate my career to advancing scientific understanding, specifically in theoretical and computational chemistry with a focus on computational biophysics.

*Christopher Poust (class of 2025).* My goal after college is to become a high school chemistry teacher, and my experience with *Project Symphony* will be very helpful in that setting. One of the largest parts of our lab is teamwork and how we can help one another in the lab. This will translate nicely to the high school environment as I will need to work with other teachers, whether in the science field or not. Whether it's matching the pacing of the other chemistry teachers, or connecting a lesson to something science-related they are learning in another class. Collaboration and teamwork are much-needed aspects of being a teacher, and I'm thankful to *Project Symphony* for allowing me to gain such experience in a great environment.

Another way my experience with *Project Symphony* will benefit me in the High School environment is by pacing when it comes to teaching various topics. Being a senior now in the lab, I've had the opportunity to help train multiple members. This includes teaching them how to operate the equipment while also teaching them about the concepts we use in the lab to further our research. Some of these concepts are fairly difficult and take a while to fully understand, which translates well to the High School Chemistry setting. A lot of the topics students learn are fairly difficult as they are new and unlike things the students have seen before. However, being able to break it down to an understandable level, and then build off of that to further their understanding is something I feel confident in my ability to do, which my experience with *Project Symphony* has greatly helped me with.

*Amani Rabadi (class of 2025).* My career aspiration is to become a Physician Assistant (PA), a role where I can integrate my passion for healthcare with the knowledge and skills I've developed through my work as a member of *Project Symphony*. My experience in the lab, particularly in studying the lipid bilayer - a structure integral to biological function and human health - has given me a strong foundation in conducting and critically reviewing research. This exposure has deepened my understanding of how research directly informs patient care, emphasizing the importance of research literacy and the ability to evaluate the credibility of information, skills essential for healthcare providers.

*Micaela Panella (class of 2025).* In the future, I hope to attain a career in research, potentially involving oncology and pharmaceutical science. While this career path is not set in stone, regardless of what I end up choosing to do in science, *Project Symphony* has provided me with great critical problem-solving and collaboration skills that are applicable to any career. The laboratory has facilitated many conversations between students on different projects and instruments where we were able to come together and learn from each other's experiences. *Project Symphony* has allowed me to develop the skills necessary to share my findings with my peers and advisor in a way that will help me succeed in future professions.

*Elizabeth Andersen (class of 2026).* I am an aspiring physician, with the ultimate goal of specializing in pediatric neurology. My experience with *Project Symphony* has altered my life drastically, equipping me with the necessary tools to thrive in medical school, residency, and beyond. Studying under and working with Dr. Lee has encouraged me to think differently, in a more analytical and problem-solving manner, challenging me to observe issues from various perspectives. I think this alone is invaluable, as critical thinking skills such as these will not only assist me in my future studies but will also provide me with a solid framework for diagnosing patients and deciding the proper course of treatment. Additionally, the *Project Symphony* has encouraged me to develop both my organizational and communication skills. With research for various articles being conducted simultaneously, alongside research pertaining to my honors thesis, there is a lot to keep track of throughout the year. Staying organized, monitoring the data collected, and communicating both progress and results is crucial now and will be especially important for my profession. Lastly, being a member of this team has taught me how to be a leader and a teacher. My time as a member of *Project Symphony* has encouraged me to take charge, to delegate tasks, and to assist the next generation of undergraduate research students. The leadership skills, as well as the knowledge I have gained from my experience with *Project Symphony* will guide me through my future career and permit me to become the best physician I can be.

*Jessica Said (class of 2026).* My experience with *Project Symphony* has been critical in preparing me for some of the challenges of medical school and a career in medicine, as I aspire to become a physician in the future. Through my involvement with the research process, I have gained an appreciation for the importance of precision and thoroughness. Attention to detail is critical for producing reliable and reproducible results, this parallels with the diligence and attention to detail required in diagnosing and treating patients, which heightened my awareness of the value of accuracy in all aspects of my work.

Additionally, *Project Symphony* has fostered a mindset of resilience and adaptability, traits that are invaluable in the ever-evolving field of medicine. Encountering unexpected results or setbacks in research has taught me to approach challenges with flexibility and a problem-solving mindset, skills that will be equally crucial in the demands of medical education and the complexities of patient care. My time with *Project Symphony* has instilled in me the core attributes necessary to excel as a future physician.

**Question #3: Can you describe some of the key challenges you have faced while working on Project Symphony and how you have addressed them? Conversely, what have been the most significant benefits of your involvement in the Project Symphony?**

*Jamie Gudyka (class of 2024).* The main challenges I faced during my undergraduate research experience were problem solving and troubleshooting. At times, when experiments that were predicted to work would fail, it would be frustrating. In those moments, it was important to take a step back and assess why things might not have been working whether it be an issue with the sample, technique, or equipment. When you are so invested in something, it can be captivating. So, when challenges occur, they can be frustrating. That is why taking a step back and looking at the bigger picture is important. When doing this, it taught me to be patient and trust the research process. When doing this and learning from the errors, I was able to then problem solve and get the desired results. This skill is something I can use beyond the scope of research and in my day-to-day life.

*Jasmin Ceja-Vega (class of 2023).* In the experience working on *Project Symphony*, one of the significant challenges was time management with other extracurricular activities, academics, sports, and research. The biggest obstacle with time management is the unexpected nature of research. Sometimes experiments would take longer than expected or unexpected issues arise. To address this, I would choose a time when I am less busy, allowing flexibility in case anything goes wrong. I also became more organized and scheduled my tasks, activities, and responsibilities. Balancing a rigorous academic schedule with D1 athletics, work, and research taught me the value of organization and time management skills that will serve me well in the future.

*Caroline Scott (class of 2025).* One of the most significant lessons I learned during my time with *Project Symphony* was the importance of patience and persistence in research. Initially, I struggled with the idea that experiments could fail or yield inconclusive results despite my best efforts. Spending hours setting up measurements was frustrating, only to encounter technical issues or data inconsistencies. However, I gradually understood that these challenges are an inherent part of the scientific process. Through guidance from Dr. Sunghee Lee and my peers, I learned that good research often requires many tries and that reproducibility is the center of meaningful scientific discoveries. This realization helped me reframe setbacks as opportunities to refine my methods and deepen my understanding. Over time, I developed a more resilient mindset that values thoroughness and precision over immediate results.

*Amani Rabadi (class of 2025).* During my time with *Project Symphony*, one of the most significant challenges I faced was dealing with unexpected results in our experiments. These moments of uncertainty required me to adapt and rethink my approach, which could be daunting. Fortunately, the collaborative environment in our lab was incredibly supportive. Being able to bounce ideas off my peers, who were working with the same drug and system using different instruments, provided valuable insights and helped me reframe my strategies. Dr. Lee, my mentor, was instrumental in guiding me through these challenges. She granted me substantial autonomy, treating me as a colleague rather than just a student. Her encouragement of curiosity and openness to my suggestions created an environment where I felt empowered to explore new ideas while still receiving thoughtful guidance and support. This balance between independence and mentorship was crucial in navigating the complexities of our research.

*Micaela Panella (class of 2025).* In my experience, the most challenging moments are also the most beneficial because it is in these moments where the group, both past members and present, comes together and shares their own experiences in such a way that we can learn even more.

*Elizabeth Andersen (class of 2026).* I have also had the incredible opportunity to present original research, alongside one of my teammates, at the American Chemical Society conference, which not only brought me deeper into the world of scientific innovation and development but has improved my public speaking skills and brought me connections to other members of the scientific community. Finally, the *Project Symphony* has provided a safe, nurturing environment for me to hone my mind, to work on my communication skills, and to come into myself.

**Question #4: Is there anything else about your experience with Project Symphony that you believe is important to share or that has had a notable impact on your academic or professional development?**

*Caroline Scott (class of 2025).* Working alongside talented and passionate peers, I honed my scientific skills and built lifelong friendships. These relationships and shared moments of discovery and success

made the experience all the more rewarding. The positive environment Dr. Lee created with *Project Symphony* is why our lab group is so successful in publishing quality research and inspiring the next generation of scientists, doctors, and dentists. One of the highlights of my time with *Project Symphony* was traveling to Japan as part of an international collaboration. My time in Japan taught me so much about the research process, including the importance of adaptability and hard work. This opportunity broadened my perspective on the global nature of scientific research and emphasized the importance of learning from other cultures.

As I look ahead to my future, I see the influence of *Project Symphony* in every step of my journey. The experiences and lessons I gained from being a part of this research group have equipped me with the skills, mindset, and passion to pursue a PhD and eventually become a leader in computational biophysics. More importantly, it has given me a deep appreciation for the research process and the knowledge that science is as much about the journey as it is about the destination. *Project Symphony* did not just teach me how to conduct research; it inspired me to embrace it as a lifelong pursuit.

*Christopher Poust (class of 2025)*. I think the most significant benefit I've gotten from *Project Symphony*, is getting to know all the wonderful people in our lab and building great relationships. When it came to high school, and even the beginning of college, most of the people I knew weren't too interested in chemistry. However, after joining *Project Symphony*, I was introduced to a group of people who were also passionate about chemistry. Being able to talk about chemistry with people who appreciate it just as much as me is something that I'm very fortunate to have. These relationships go beyond the lab as well, as I have gotten to know a lot of the members outside of the lab, building some of my strongest friendships that I'm sure will last a lifetime.

*Amani Rabadi (class of 2025)*. In addition to the technical knowledge I've gained, presenting our findings at local and national conferences has honed my ability to communicate complex scientific concepts in a way that is accessible to people with varying levels of familiarity with the topic. This skill is not only vital in a healthcare setting, where patient education is key to fostering understanding and autonomy but also in life, where clear communication can bridge gaps in knowledge and improve outcomes for individuals and communities. The collaborative environment in the lab has further reinforced the value of working in educational spaces that encourage shared learning, a principle that I believe will guide me toward successfully achieving a variety of goals. One of the most significant benefits of my involvement in *Project Symphony* has been the deep sense of family I've found within the lab. It's not just about the people I worked with daily but also about connecting with those who came before me and those who will continue the work in the future. There is a shared sense of purpose and camaraderie, as if we are all part of a larger narrative of discovery. Joining this lab felt like stepping into a lineage of researchers who have paved the way with their contributions. This bond has been incredibly empowering, giving me confidence and a strong sense of belonging.

This familial atmosphere extended beyond scientific collaboration. We celebrated each other's successes and learned from our setbacks, forming bonds that were both personal and professional. This experience has shaped how I approach challenges, viewing them not as isolated problems but as opportunities for collective growth. The supportive network and shared commitment to discovery have profoundly impacted my approach to problem-solving and my confidence in tackling future challenges.

*Micaela Panella (class of 2025)*. In my experience, joining *Project Symphony* is joining a family. There is such a tight knit community established between past *Project Symphony* members and current *Project Symphony* members due to the welcoming and encouraging environment Dr. Lee provides for us in the lab. The lab is a place where students can bounce ideas off each other, learn from each other, and always find a helping hand. No matter what year in your academic career you join, everyone is faced with the same positive energy and other members' willingness to help you succeed. There are many students who have graduated from Iona whom I still keep in touch with whom I may not have had the privilege to know if I had not joined *Project Symphony*. *Project Symphony* has not only immensely enhanced my problem-solving skills, but also enhanced my collaborative skills and self-confidence when communicating with my peers and advisors about my ideas and findings in research.

### **A unified melody – The whole is far greater than the sum of its parts** **Sunghee**

Each individual student brought their enthusiasm and love for science, and in the end, their professional growth and even more importantly personal and emotional growth they experience through the collaborative teamwork will last for their lifetime. For all those who start their academic careers now,



reading a story like a Project Symphony may make the tasks ahead seem daunting. That is how I felt in the beginning for sure. The beginning of this scientific orchestra began with one student. This initial solo act laid the foundation for what would become a rich, multifaceted research ensemble. As our group expanded, we transitioned from a solo act to chamber music, each new member adding depth and complexity to our scientific repertoire, now, with a full-fledged research symphony. In my role as conductor, I've witnessed the beautiful convergence of diverse talents and perspectives, each student contributing their unique voice to our collective pursuit of knowledge.

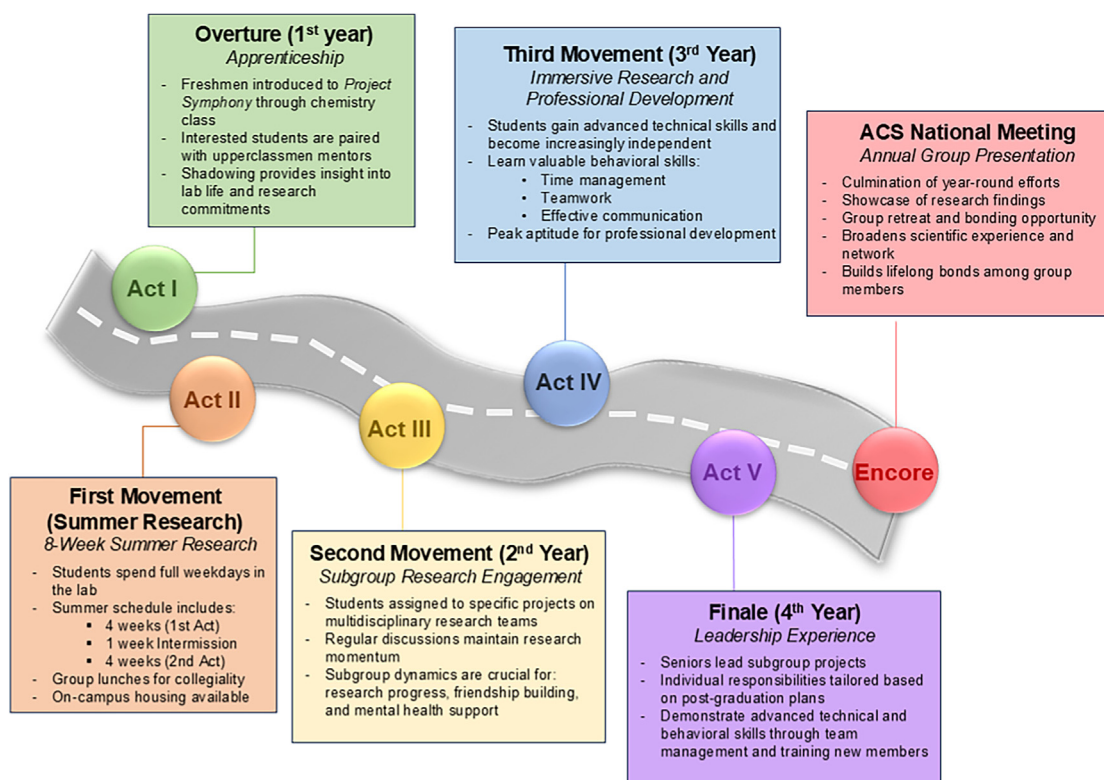
**Suggestions for composing and maintaining a thriving undergraduate research group**

**Sunghee**

Based on our collective experience, we've found that the following key elements are crucial for initiating and maintaining a thriving undergraduate research group.

- (1) Early recruitment and extended research opportunities: We've discovered that offering summer research programs is particularly effective in providing immersive research experiences.
- (2) Holistic project design: Rather than assigning isolated tasks, we focus on creating projects that foster a comprehensive understanding and encourage collaboration among team members.

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Key notes of the *Project Symphony* pedagogical framework



**Project Symphony members at the ACS Fall meeting in August 2019, in San Diego, CA**

Ten *Project Symphony* members fill the entire row at the Colloid and Surface Science Division poster session (top). Our group typically makes a big splash at the national meeting each year (bottom in Denver, CO, 2024).

- (3) Positive group dynamics: We emphasize a balanced approach that combines hands-on research with regular social interactions and emotional support.
- (4) Interdisciplinary collaboration: We actively promote cooperative learning by forming cross-disciplinary research teams, and bringing together students from various academic backgrounds.
- (5) Cultivating a sense of belonging: We strive to create an inclusive culture where every team member feels valued and respected. This includes developing a unique group identity through elements such as a research group name, logo, and branded safety equipment.

The strategies we've implemented have fostered a dynamic and productive undergraduate research ecosystem, yielding multifaceted benefits. This approach not only enhances students' academic and professional development but also invigorates our research agenda with fresh perspectives and innovative methodologies. The synergy between mentorship and collaborative discovery has proven to be a powerful catalyst for advancing scientific inquiry while simultaneously cultivating the next generation of researchers. Our experience in *Project Symphony* underscores the transformative potential of



**The conference is also a fantastic opportunity for group members to bond while exploring new cities and their surroundings**

*Project Symphony* members at the ACS Fall meeting in August 2024, in Denver, CO (top), and in August 2022, in Chicago, IL (bottom).

undergraduate research engagement, offering a model that can be adapted and scaled across diverse educational contexts to enrich both student learning and the broader scientific community.

### **Finale**

Reflecting on my journey leading an undergraduate research group, I've come to appreciate the profound impact of collaborative scientific endeavor. Much like the evolution from a solo performance to a grand symphony, our research group's growth has been a testament to the power of collective passion and shared purpose.

This orchestration of intellects has not only produced compelling research but has also fostered an environment where creativity flourishes and innovation thrives. The resonance of our combined efforts extends far beyond the confines of our laboratory, influencing the broader scientific community and inspiring the next generation of researchers. Indeed, the symphony we've created together is a testament to the transformative power of collaborative undergraduate research - a melody of discovery that continues to evolve and inspire.



**Project Symphony members at the end of year celebration, Dec. 2024**

To close out this amazing semester, we all gathered on the last day of classes to celebrate everything we've accomplished (top). Our gathering was a fun mix of camaraderie and creativity, featuring a coloring session and the gingerbread house competition (bottom).

**ACKNOWLEDGMENTS**

As the saying goes, "It takes a village to raise a child," and in our case, it takes a dedicated community to drive research forward. We are sincerely grateful to the funding support that have made our work possible, including the National Science Foundation, ACS PRF, and the Camille & Henry Dreyfus Foundation. Additionally, we would like to acknowledge and appreciate The Patrick Martin Foundation, Iona University, and all current and former members of Project Symphony for their unwavering dedication and enthusiasm.

**REFERENCE**

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