Personal Stuff:

When I was a junior in high school I read *A Wrinkle in Time* by Madeleine L'Engle and I decided I wanted to be an astrophysicist. I had always been fascinated by outer space and the greater universe. When I was small I wanted to be an astronaut, because the images I had seen of earth from outer space terrified me in ways that nothing else could. *A Wrinkle in Time* showed me the possibility, however imaginary the book may be, of using science, particularly physics, to explore and understand the universe. I mark this moment as the hesitant beginning of my scientific career.

The story of how I came to physics through a book is appropriate considering that I am double majoring in Physics and English. Most people's first reaction to this unorthodox combination, is "why?" in varying tones of skepticism. My answer is that though my majors seem to be opposites, they actually compliment each other. I believe my English major has trained my brain in a different dimension than my physics major, ~~thus~~ allowing me to approach physics problems more fully. My English major also has allowed me to grow as a writer, and has trained me to write concisely and well. Good writing is good writing, no matter the discipline, and my English classes have made me a good writer.

I took General Physics I my first semester of college, as the first step towards becoming an astronomer, but not sure if I would stick with it. On the first day of class, my General Physics professor had us fill out a short questionnaire about our expectations for the class. The last question asked what about the class made us most nervous. I wrote that I was scared that I would not like it and decide to not study physics. I was newly eighteen, and I did not know much physics, but I knew that I loved the stars and that I had decided to use physics to consummate that love. If not physics, I was not sure what else. After taking a few physics classes, I have reassured my freshman-self that I do indeed love physics. I love its collaborative nature, the loneliness, and the working for hours for one small result. It is like holding your breath for hours because the eventual exhale is that captivating. I enjoy physics because I love the nonlinear, long process of solving problems. I fell in love first with problem sets, and later with the undefined, constantly adjusting process of research.

Relevant Background and Experience:

The summer after my sophomore year I was accepted into an REU at Notre Dame. I worked with Chris Howk on using spectral stacking to detect Fe XIV absorption in the Milky Way's Halo in order to determine a constraining mass estimate of the baryonic mass of the Galaxy's Halo. It was my first research experience and I went in with no idea of what to expect. My advisor sent me papers to read before the program. I remember sitting with a friend, reading the papers, and understanding little of what I read. The first day of the REU program I sat in my advisor's office and we talked about the papers he had sent, and my project for the summer. He told me that I was not supposed to understand everything right away. My job was to ask questions and seek to learn. I came to this REU having never taken an astrophysics class, only one upper division physics class, and not sure that I belonged. But that first day spent in my advisor's office, given the freedom to ask questions, opened me up, and gave me hope that my time at Notre Dame would be fruitful.

Many summer afternoons were spent like that: him giving me lists of tasks to accomplish, and me asking questions. We talked about spectroscopy, star formation, redshift, and what a parsec is. I learned that astronomers use units of centimeters and grams even though the things they measure are enormous. We talked about what life is like as a research professor, and an astronomer. I learned that scientists spend much of their day writing. I learned that research rarely goes as planned and that half the battle is being able to adjust as you go. I learned that an astronomer's work is largely in front of a computer. I learned Python, and the magical satisfaction that comes from getting code to run. Thought this experience, physics became more than homework questions assigned to me—I got to ask and answer my own questions—and as a result, I began to think of myself as a scientist.

When I published my first paper (albeit a research note of the American Astronomical Society) on the work I had done at Notre Dame, it further cemented my sense of becoming a true scientist. And a few months later, when I gave a poster presentation at the April APS meeting, and won an award for best student presentation, I became even more of a scientist.

Following my experience at Notre Dame, I wanted to continue with astronomy research, and get a taste of observational work. The summer after my Junior year, I applied for and was offered an astronomy REU at the University of Wyoming, with a heavy observing component. My cohort of 7 other students and I learned to operate the University's 2.3m telescope and we spent every night on sky that the weather would allow. We were working on the Monitoring AGN with Hβ Asymmetry (MAHA) project. After a few weeks of looking at AGN I learned to recognize individual ones by the shape of their Hβ line. I learned the particular magic of staying up all night working the telescope and the satisfaction of putting together an efficient night of observing. I learned that I am a spectroscopy girl and that if I am doing extra galactic spectroscopy, I will be happy with my research. I learned the ups and downs of sharing work with colleagues. At Notre Dame I worked on my project with only my advisor—not even a graduate student. I enjoyed the independence and opportunity to develop a relationship with my advisor that the experience provided. But I wanted to experience working in a larger research group, and the University of Wyoming gave me that experience.

My REU at University of Wyoming was very student-led. At Notre Dame I consistently checked in with my advisor and we talked about my questions and next steps. At University of Wyoming, my cohort and I worked largely on our own. We observed every night, worked on data reduction and analysis during the day, and read papers about the objects we had individually chosen to focus on. From this I learned how to direct my own work, and how to prioritize where to direct my focus. I expect this experience with almost entirely self-directed work to be valuable as I move into graduate school.

Another valuable piece of my experience at University of Wyoming is that it was an entirely astronomy REU. At Notre Dame, it was a mix of subfields, with astronomy being a minor piece of that. At University of Wyoming, I was with 7 other students who were excited about astronomy, and we interacted with faculty and graduate students all also doing astronomy. If my experience at Notre Dame molded me into a scientist, University of Wyoming is where I started to become an astronomer.

Broader Impact:

Science education has always been close to my heart. When I was in high school my mother and I would regularly discuss various teaching pedagogies and their respective stances on STEM education. I want to earn a Ph.D. in astrophysics and then spend my life as a professor, doing research and sharing my love of physics and the stars with my students. I also want to work in science outreach, and find ways to use my university's resources to provide science opportunities and experiences for local K-12 students.

I have been able to work in science outreach in a few venues during my time at Regis. When I was a junior, I helped to organize a project where myself and two other students went into local high schools and talked to math and science classes about college and pursuing higher education in STEM fields. We told our winding stories about how we ended up as STEM majors, engaged the students in hands-on activities, and fielded questions about college, being a STEM major, adjusting to higher education, financing college, etc. As two of us were women, we talked about the female experience within STEM majors. We challenged the students' ideas of what a scientist is, and told them that scientists are people who are curious about the natural world and who have chosen to explore that curiosity through the means of science. We told them that scientists are not just male, not just white, not just people in lab coats. Instead, we told them that scientists are regular people who are curious and have chosen to answer their questions through scientific study.

The other large science outreach event I have helped with is an annual spring event called "Science Sunday," hosted by my university. Science Sunday is a Sunday in April where the Regis science building is full of students and faculty putting on demonstrations and experiments for children in the community. Each year there is a steady stream of children and their parents, learning about chemistry, biology, neuroscience, physics and astronomy. Each year I am amazed by the kids' curiosity and excitement. Last year I helped work the telescope station. One little boy, probably about six years old, comes running up the the telescope station, his mother walking behind him. He smiles eagerly and shyly at me while his mother explains that he is fascinated with black holes and watches every documentary about them that he can, and that he has a question for me. He asks me "do you know about Hawking radiation?" and I try to hide my surprise at such a question coming from a six year old. I tried my best to explain Hawking radiation and he seemed satisfied with my explanation. It is these moments that remind me why I love science. I saw that little boy's excitement and it mirrored my own. I want to encourage young people, from kindergarten to college and graduate students, in their curiosity and scientific excitement.

In addition to K-12 students, I really enjoy working with non-physics majors taking physics classes. I have been a Teachers Assistant in General Physics labs for three years now. My favorite thing about being a TA is helping students to understand concepts they thought they never would. This experience has taught me how to teach, and has taught me patience and compassion for introductory physics students.I believe the nonlinear, conceptual, rational physics way of thinking is a valuable skill in any career. It is important to me to help impart that thinking and an appreciation for it to non-physics majors who find themselves, often reluctantly, in a physics classroom. I am interested in exploring interdisciplinary methods of pedagogy in order to better educate introductory physics students who are non-physics majors.