

Professional Evaluation and Growth Plan

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Chapter 1

Introduction



1.1 Background

My name is Jordan Hanson, and I am formally submitting my first Professional Evaluation and Growth Plan (PEGP). As required by Whittier College, and in accordance with the regulations in the Whittier College Faculty handbook, the material herein pertains to my first complete academic year as a tenure-track Assistant Professor of Physics and Astronomy. Being new to the Whittier College community, I have included this professional introduction for those readers to whom I have not yet been introduced. I look forward to meeting and working with my colleagues in other departments over the years, and I hope that this brief introduction will explain why I chose to become a professor. Accordingly, I share my vision for teaching physics and scholarship in the area of *astroparticle physics* at Whittier College.

My professors and colleagues in the professional-track physics program at Yale University inspired me to excel beyond what I thought was possible for myself. I was introduced to the world of academic scholarship by faculty who had known they would enter this world from from a young age. I fell in love with physics for the beauty of its theoretical simplicity, and the surge of excitement as observations spark to life through hard laboratory work. After receiving my Bachelor of Science degree, I landed at UC Irvine, the home of the Nobel Laureate who made the first observation of a sub-atomic particle called a neutrino. UC Irvine excels in the study of extrasolar, high-energy sub-atomic particles: *astroparticle physics*. I was introduced to Professors Steve Barwick and Stuart Kleinfelder. Dr. Barwick is a professor of physics in the Department of Physics and Astronomy, and Dr. Kleinfelder is a professor of physics in the Department of Electrical Engineering. Together we embarked on a journey to produce world record-breaking observations of high-energy neutrinos from beyond the solar system.

UC Irvine served as a training ground for my ability to teach, and I began to understand why teachers love to witness the flash of light in a student's eyes. I taught as an assistant under Dr. Barwick, serving students in sections associated with introductory physics courses comprised of several hundred students. During the early semesters in my graduate career, I was teaching physics sections of twenty students

each for five continuous hours, three days per week. After concluding my teaching duties, I focused on research for several years. Upon completing my dissertation and receiving my doctorate, I solo-taught an introductory physics course during one of my post-doctoral fellowships. During that summer I learned the difference between *teaching* a course and *creating* a course. I enjoy creating new courses, and I have already created and taught new courses for students at Whittier. Above all else, I hope my work at Whittier will serve to *enlighten* our students.

1.2 General Reflection and Future Directions

Any general reflection for academics at Whittier must begin and end with our students. Over the past year and a half, I have chosen to become an *active participant in this community* and to push beyond what is required of me as a young professor. I have taught introductory physics courses to students who have no prior experience in physics, and created a new advanced computer science course. I've attended conferences to improve and expand my teaching methods, taking advantage of the broad research in physics education. I decided to take a class from a professor in another department for the sheer joy of learning, but also to learn methods from an experienced teacher. I've involved a group of students in all facets of my research, including software and algorithm development, firmware development, and digital storytelling. Two of these students won Keck Fellowships and have engaged in summer physics research in my laboratory. We are preparing to become part of a collaboration of researchers who plan to build a world-class astroparticle detector at the South Pole. Additionally, I've become a mentor and advisor to a student organization, and helped serve the Math Department in a tenure-track faculty search. Each action I've taken during these past months has been geared towards serving our students thoughtfully and rigorously, to provide them with a quality education and research environment.

Despite these accomplishments, I am not satisfied with some aspects of my teaching. I was surprised to find that in my introductory courses, a group of students felt that the level of mathematical and technical detail was too advanced, and that the pace of the courses was too rapid. A group of students has been vocal in their assessment of these issues, and I take them seriously. Some of my students in an introductory course actively worked with me in office hours to find common ground. It is my hope that in the coming years, I will be able to implement a pace and difficulty level suitable for the academic environment at Whittier that *does the most good, for the largest number of students*. Although I do not feel it would be right to omit core physics principles from introductory courses, I will rely on the past experiences of my department to find a solution. My hypothesis is that many of my students in introductory courses are not prepared to make logical abstractions of physical systems, and require a larger number of concrete examples and demonstrations before gaining that ability. I will work diligently during the coming academic year to boost the abstract problem-solving ability of my students through leading by example.

Chapter 2

Teaching

2.1 Teaching Philosophy

The heart of the intelligent acquires knowledge, and the ear of the wise seeks knowledge. - Proverbs 18:15

I guess you could call it a “failure,” but I prefer the term “learning experience.” - Astronaut Mark Watney in *The Martian* by Andy Weir

Teaching is about beautiful failure. Learning takes place between at least two people where at least one lacks knowledge. A lack of knowledge is an advent to *enlightenment* and is therefore beautiful. Regardless of the teaching methods chosen for a given teacher and student, the student should leave the encounter *enlightened*, with increased knowledge of the truth. The success of the encounter is measured by the varying degree to which the student can retain, apply, understand, and reflect upon the knowledge. I believe that lifting a student learning physics from retention to reflection is beautiful, in that I witness a student extending their mind outside *their model* of the world, into *the model* of the world. In general, both the teacher and student succeed imperfectly in imparting ideas about *the model* of nature, and therefore the process will contain periodic failures. Further, the physics model itself may be an imperfect description of true nature. Growing through these “failures” is a hallmark of learning modern physics, a subject built upon increasingly accurate approximations to the truth.

Teaching physics begins with defining the concept of a “system” about which we can make measurements. All physics students must begin at this common place. With well-defined concepts of distance, mass, displacement, and time, the entire subject of *classical physics* may be undertaken. Students who are non-majors usually experience exclusively classical physics. Physics majors grow through the inaccuracies of classical physics to *modern physics*, which includes relativity and quantum mechanics¹. Mastering these subjects represents maturity made possible through diligent and patient teaching. Teachers capable of bringing students to the advanced level and enlightening beginners are not molded upon the completion of graduate school. Physics teaching requires experiences shaped by failures and successes enlightening students studying classical and modern physics.

A good teacher loves growth. Each semester at the beginning of my introductory courses, I give a speech about learning to embrace failure entitled “It’s OK to Be Wrong.” The introductory student fears being wrong, losing points, and receiving a low grade. Counter-intuitively, those students who

¹Students satisfying liberal arts requirements via specialty courses do experience non-classical physics qualitatively.

embrace their mistakes and learn from them turn out to be the strongest students. Converting failure to growth has two components. First, there is no substitute for *hard work and sacrifice*. A good teacher leads by example, pouring effort into the semester until the job is done. A good teacher works to master new skills by attending teaching conferences in his field, consulting students through mid-semester feedback mechanisms, analyzing student evaluations. A good teacher also works to become nimble, switching from method to method, until the suitable vehicle properly engages the student. Second, a good teacher *creates a proper learning space*. In my classrooms, no student is penalized for being wrong, with the single exception of taking exams. By creating a space in which it is ok to be wrong, we take advantage of the learning moments brought forward by mistakes, and make real progress.

A good *professor* is a special kind of teacher, in that he is a teacher that also performs scientific research. A good professor successfully involves undergraduate students in his research. One crucial fact about myself that I learned during the past two semesters is that I love the *instructive* act of research just as much as I love the *investigative* act. Even when I am conducting research with my students, I should still be instructing them, and I've found that I love it. The instructive act of research lies in *pausing to reflect* upon what our actions in the laboratory imply. Whether a procedure succeeds or fails my laboratory, the student and I must take time away from the procedure to step back and understand *why* we observed the result. I hope to grow as much in the area of research instruction as I will grow in classroom instruction, and to produce students who will become quality researchers.

Instruction of Students in Introductory Courses

The first categorization of physics student at Whittier College is whether they are a liberal-arts *non-major* or *physics major*. Non-majors encounter physics for two semesters in either a *calculus-based* or *algebra-based* environment. We categorize students in this fashion because classical physics at the standard undergraduate introductory level is built upon single-variable calculus, with some multi-variable or vector calculus introduced in the second semester. Students who will not take calculus for their degree can still learn core mathematical concepts like vectors and instantaneous quantities and apply them to physics. Thus, *non-major* students usually take the *algebra-based* version of mechanics, and *physics majors* and students who have chosen another technical degree take the *calculus based* version of mechanics.

It is important for three reasons to deliver a quality physics experience to non-majors in algebra-based physics:

1. **Basic Curiosity.** I have given public colloquia at universities, seminars in physics departments, public lectures to children in libraries and adults in astronomical societies. I need to experience people's curiosity to be a good professor. I've continued this practice as Whittier professor by giving a lecture at Los Nietos Middle School. ² All people are naturally curious, and seek an understanding of nature. Further, people have a need to know *that the answers exist*, even if we do not yet fully grasp them as a society. Whittier non-majors are naturally curious, and I believe good teaching should therefore *convince them that physics is interesting* by enticing their natural curiosity. I have built into the algebra-based curriculum specific learning activities designed to entice student curiosity. Examples are students presenting popular science articles to the class, and hands-on circuit projects done at home. As a professor, I regularly give colloquia at Whittier and encourage my students to participate, to make them curious about astroparticle physics research ³. These strategies are in addition to our standard toolbox in the Department of Physics and Astronomy, which I address next.

²A shared experience among physicists: when we bring our work onto an airplane, the passenger seated next to us *often asks us to teach them*.

³See supporting materials for notes from students on my spring colloquium.

2. Improvement of Analysis Skill

- Think-Pair-Share
- Just in Time Teaching
- Integrated Laboratory and Lecture Format
- Hybridization of traditional and research-based methods

3. Applications to Society

Instruction of Students in Upper-division Courses

2.2 Introductory Course Descriptions

Some text.

2.2.1 Analysis of Student Evaluations

Some text.

2.3 Advanced Course Descriptions

Some text.

2.3.1 Analysis of Student Evaluations

Some text.

2.4 Proposed Future Courses

Some text.

2.5 Reflections and Future Directions

Some text.

Chapter 3

Scholarship

Hello, here is some text without a meaning. This...

Chapter 4

Service

Hello, here is some text without a meaning. This...

Chapter 5

Advising and Mentoring

Hello, here is some text without a meaning. This...