**Sara Kate May**

**RET 2010: A Physics MOSAIC**

**Returning RET 2011**

**Final Report**

I spent the summer of 2009 working at MIT Haystack Observatory as part of the RET program. That summer, my partner, Chris Clements, and I designed a set of lessons for high school physics classes that take advantage of MOSAIC, or Mesospheric System for Atmospheric Investigations in the Classroom. MOSAIC is a relatively inexpensive tool for measuring mesospheric ozone concentration, and it was developed here at Haystack specifically for use in classrooms. My partner and I designed a teaching unit that had three main units: a final project, lessons on data, uncertainty, and measurement, and lessons on individual physics topics.

During the school year of 2010-2011, I used the Data, Measurement, and Uncertainty we designed last summer in my Honors Physics and AP Physics C classes. Specifically, I used the Power Point lessons and first activity (on quantifying the advantage of large data sets). I found that were very effective for teaching students the basics of data analysis and statistics, and I really liked being able to give my students a little bit of familiarity with these topics. I also used a number of the lessons on individual physics topics with my Astronomy and Honors Physics classes. For Astronomy, our lessons on wave basics, optics basics, the electromagnetic spectrum, and energy levels and spectra helped me introduce the relevant science topics into my class in a way that was appropriate for the high school level (unlike many astronomy texts, which are written for college students) while still providing insight into the “why?’ behind the concepts. On the negative side, I did find that the lessons often included too many physics details for an astronomy course, and I needed to modify some of the lessons by eliminating some of the complexity intended for physics students. In Honors Physics, I used our lessons on wave basics, wave properties, the electromagnetic spectrum, and optics basics. In this case, I found that I wished the lessons included a bit more quantitative analysis and physical insight, as well as more coverage in terms of topics, especially in optics. I found myself needing to supplement the lessons with extra lessons to cover the parts of my curriculum I considered most important. In all cases, however, I found the accompanying worksheets that we created to be a good way to keep students on task with the lessons in class, and I thought the mix of problem solving and short answer responses to be well-suited to the material and my students’ understand. Although I had hoped to end my Honors Physics class with the final project we designed last summer, I found that I ran out of time in the actual school year (in part due to a change in the pace of the course and in part due to our unusual number of snow days over the winter!).

I spent four weeks in the summer of 2011 modifying the lessons we designed last year and clearing permissions for all figures and diagrams used in the lessons. Specifically, I spent a lot of time supplementing the lesson on optics, which was one of the lessons I found most lacking when I used it in my physics class. It is now quite thorough, including topics relevant for both physics and astronomy courses and applications and examples focusing on MOSAIC. It is also quite long (61 slides), and I thus created two separate files from the original Power Point lesson, one designed for astronomy courses and one designed for physics courses. The lessons now include almost everything included in a typical physics class on the subject of optics, so I am optimistic that this will be a useful resource for other physics teachers. I know it will be useful for my classes next spring, and I look forward to using it. I also know that the significantly shorter version of the lesson for astronomy classes includes many topics that spur great discussion with students.

Although I hadn’t had a chance to use the final project in the last school year, I also spent a good deal of time this summer modifying and updating the project description. Because another year of data have been collected since last summer, a number of graphs needed to be updates and revised, and, now that we are (finally) leaving the solar minimum, there are some projects that make sense to propose for students this year that would not have been possible last year. Also, the addition of a spectrometer in Alaska means that students can now analyze differences in ozone concentration across two sites. This is part of the exciting thing about the MOSAIC system; with constant access and updates to the data, more research possibilities are always being created. I think that the modifications I made to the final project documentation make it more accessible for both teachers and students and provide some clear pointers on doing research that is interesting and relevant.

I look forward to using the lessons in A Physics MOSAIC in my classroom again this school year, and I look forward to their being made available on the Haystack website for other teachers to use and download. I was happy to present some of my lessons at the RET Workshop before the start of my time as a returning RET, and, based on the conversations I had there, it sounds like there is significant interest in some of the units, especially those on measurement and data analysis. There is already some significant enthusiasm at my school for MOSAIC and my work with it, and I would love to install a spectrometer in our observatory so that our students really feel a sense of local connection to the data being collected.

I am very grateful to everyone at Haystack for two summers of fantastic and rewarding work. While Madeleine Needles, who retired during this past year, was definitely missed this summer, Vincent Fish, Phil Erickson, and KT Paul did a great job supporting me and helping me navigate the logistics of my RET project this summer. Alan Rogers, along with Vincent and Phil, again provided incredibly valuable insight into the scientific applications of MOSAIC, and their feedback helped improve my lessons. It might have been a bit lonely returning this summer alone without my partner from last year’s work, but the entire Haystack community (especially this summer’s RETs Katie and Vincent) was so welcoming and friendly that I never felt isolated. Working at Haystack as an RET has been one of the most rewarding professional experiences I’ve had, and I was especially pleased to be able to attend AGU over the winter to present our unit. I am very grateful to everyone who made these experiences possible.

Sara Kate May

August 11, 2011