Teaching Portfolio

by

Andrea Lang

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Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison
The Delta Program in Research, Teaching, and Learning is a project of the Center of the Integration of Research, Teaching, and Learning (CIRTL—Grant No. 0227592). CIRTL is a National Science Foundation sponsored initiative committed to developing and supporting a learning community of STEM faculty, post-docs, graduate students, and staff who are dedicated to implementing and advancing effective teaching practices for diverse student audiences. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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Spring 2011

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Why Teaching?

My Journey Toward an Academic Career

Even after almost 15 years, I can still recall the excitement of being accepted into a magnet high school for science and technology in the culturally and ethnically diverse suburbs of Washington D.C. Being a female student of Mexican descent, I also remember the overwhelming feeling of surprise, tinged with disappointment, that I felt upon learning that I was one of only five Latino students in a freshman class of nearly four hundred and twenty. The lingering sensation of discouragement resulting from that circumstance did not disappear even years later at the University of Wisconsin where, while sitting through undergraduate and graduate courses in physics, calculus, and atmospheric dynamics, where I noticed I had very few female classmates, and even fewer Latino classmates. However, these circumstances did not dissuade me from pursuing my scholarly interests, in fact, they have served as a source of motivation.

As an undergraduate at the University of Wisconsin, I was accepted into the Chancellor's Scholarship Program, which encouraged underrepresented students to participate in a variety of co-curricular and service activities involving the less fortunate in both the academic and metropolitan communities. Our service projects not only included the aspects of tutoring elementary school ESL students, public parks cleanup, and food drives, but also contained a social aspect. The program paired each student with a faculty mentor and encouraged conversations between students of diverse backgrounds, all of whom shared the similar ambition of obtaining a college degree. Without this program I would have continued to feel the sensations of discontent and uncertainty that my minority status occasionally engendered within me as a young scholar. However, as Chancellor's scholars, many students, including myself, came to realize, not in a sudden epiphany but in a gradual affirmation, that as young scholars we could decide how to weave the separate threads of our diverse life experiences and our college educations into the strong fabric of our professional careers.

Growing up with parents who as children worked part time as farm workers in deep south Texas, I learned the importance of perseverance and a solid work ethic, as well as the intrinsic interest and sometimes grave impacts associated with the variable weather. This milieu produced, in me, a student with excellent study habits as well as an interest in scholarly pursuit of the science behind the variable weather that had captured my imagination and had had such an impact on my field laboring relatives. With encouragement from my supportive family, I graduated with my degree in Atmospheric and Oceanic Sciences in three years, however, formal study of meteorology had only deepened my interest in the weather and I knew immediately that I wanted to continue my education and seek an advanced degree in the same field.

My hard work was not limited to the classroom. For five years, as a walk-on turned captain of the University of Wisconsin Women's Track and Field team, I accepted the challenge of maintaining a balance between my professional life (pursuing both my B.S. and M.S. degrees) and my personal life as well as athletics and associated service. In fact, my ability to do so was noted by my athletic and academic honors as I was named CoSIDA/ESPN The Magazine Academic All-American 2006; Diversity Issues in Higher Education Magazine's Arthur Ashe Jr. Sports Scholar 2005 and 2006; and Academic All-Big Ten four straight years (2003-2006). As an athlete myself, I knew first hand how hard it was to maintain the delicate balance between coursework and athletics.
After volunteering my time to teammates in need of tutoring, I realized I could reach more students if I volunteered such assistance to the entire athletic department. I quickly became aware that many of the athletes seeking tutoring did so because they often felt embarrassed or reluctant to seek help from their professors. It was in this setting that I first began considering a future teaching at the college or university level.

While working on both my M.S. and Ph.D., I took every available opportunity to teach in atmospheric science courses at the introductory and advanced level. My effectiveness and abilities in teaching as a teaching assistant were noted by my Department, as I was awarded the Wahl Award for an outstanding performance as a Teaching Assistant. In the spring of 2009, I was employed as a Lecturer in the Department of Atmospheric and Oceanic Science at UW-Madison. Though the idea of standing in front of 200 students in a classroom terrified me, I knew it was time to overcome my fears and do what I knew I enjoyed doing. My initial thought of becoming a university professor was intensified by these teaching experiences and my confidence in the likelihood of thriving in that setting has grown. Aspiring to be the faculty member who is viewed as a role model not only for underrepresented students, but for those in need of an approachable professor, I worked toward a Certificate in the Delta Program for Research, Teaching and Learning. Participating in such a program has pushed me up the path toward becoming the outstanding teacher and mentor that I know I am. As I look to the future, perhaps my personal perspective on the pursuit of my interests in atmospheric science and in teaching, motivated by my unique personal story, will inspire my future students and colleagues.
Andrea Lang
A Teaching CV

Teaching Experience

Lecturer  
Dept. of Atmospheric and Oceanic Sciences, University of Wisconsin – Madison  
Spring 2009

AOS 100, Introduction to Weather and Climate, Lecture;
As the lecturer for a class of roughly 200, I was responsible for the successful implementation a 3 credit lecture based course. This included creating homeworks, exams, a course website, the syllabus, lectures and demonstrations, and holding regular office hours with students, as well as working with a TA to facilitate the organization and distribution of course materials.

Teaching Assistant
Dept. of Atmospheric and Oceanic Sciences, University of Wisconsin – Madison

As the TA for the 2 hour laboratory, my role included creating a syllabus, constructing, administering, and grading labs and assignments. Worked directly with students to develop case study projects, prepare weather discussions, and stimulate discussions.

Spring 2007, 2008, 2010 AOS 100, Introduction to Weather and Climate Lecture;
In this large lecture of 400 students, I was the liaison between students and professor, held regularly attended office hours, created a new course website, and proctored exams.

Spring 2006 AOS 101, Introduction to Weather and Climate Lab;
As the lab instructor, created weekly labs, assignments, assessments, and lectures focused on relating the lecture material to its real world applications.

Guest Lecturer
Dept. of Atmospheric and Oceanic Sciences, University of Wisconsin – Madison

Spring 2010, AOS 100, Introduction to Weather and Climate;
Enthusiastically presented five lectures throughout the semester on topics ranging from the structure and composition of the our atmosphere, to the concept of humidity and the development of precipitation.

Fall 2009, AOS 452, Synoptic Meteorology – The Frontal Cyclone;
Gave the well received first and second lectures for the semester, a review of undergraduate dynamics necessary for upper level synoptic meteorology.

Spring 2006, AOS 252, Introduction to Weather Analysis and Forecasting;
Presented a guest lecture that introduced the students to the concept of the thermal wind and its application for forecasting.
Instructor  
College Access Program, Student Diversity Programs, School of Education, University of Wisconsin – Madison

College Access Program offers students from economically disadvantaged backgrounds, who are completing their freshman, sophomore, or junior year in high school, an opportunity to improve their academic and college readiness skills. I prepared a 2.5 hour, daily 3 week summer workshop course on “The science of thunderstorms.”

Academic Tutor  
Division of Intercollegiate Athletics, University of Wisconsin – Madison

Tutor for Math and Atmospheric and Oceanic Science courses for college student athletes.

Track and Field Coach  
April 2008 - June 2009
Madison Metropolitan School District, Madison West High School

Taught and coached students to pole vault and high jump, events that emphasize building student confidence, increasing student self esteem, and team building.

Teaching Certificate

- **Certificate – Delta Program for Teaching, Learning, and Research** - Developed as an NSF funded program to mentor and help current and future faculty succeed in the changing landscape of higher education in the science, engineering, and math fields.

  *Delta Courses:* Diversity in the College Classroom, Informal Science Education for Scientists, The College Classroom, Teaching Large Lectures, Delta Teaching Internship, and Research Mentor Training

Teaching Related Achievements

- Ford Foundation Predoctoral Diversity Fellow, Ford Foundation administered by the National Research Council, 2008-Present

  Predoctoral fellowships will be awarded in a national competition administered by the National Research Council (NRC) on behalf of the Ford Foundation. The awards will be made to individuals who, in the judgment of the review panels, have demonstrated superior academic achievement, are committed to a career in teaching and research at the college or university level, show promise of future achievement as scholars and teachers, and are well prepared to use diversity as a resource for enriching the education of all students.

- Wahl Award for an outstanding performance as a Teaching Assistant, University of Wisconsin-Madison Dept. of Atmospheric and Oceanic Sciences, 2009
Experience creating and evaluating the following teaching tools:

- Syllabus, including statements of accessibly, inclusive classroom policies
- Lectures, including interactive components
- Homework, in the form of problem sets, laboratory activities, hand analyses relating to real world problems
- Exams for large lectures and quizzes for small labs
- Case studies, both group and individual
- Teaching assessments, to evaluate and reflect on my own teaching
- Laboratory activities, from specifically defined tasks leading to more open ended activities

**Teaching Assistant Evaluations: A sample from Fall 2009, AOS 452, Synoptic Meteorology**

- “Andrea clearly has a strong command of the course material. She is enthusiastic and always willing to help.”
- “Andrea is an awesome TA. She really knows her stuff and sometimes seems to rival what Prof. Martin knows. She was very helpful with all the labs and papers.”
- “I enjoyed working with Andrea this semester. [She] was very helpful and approachable for questions.”
- “Excellent TA – Great grasp of material. Would highly recommend to anyone”
- “Andrea was very helpful.”
- “I thought all the lab assignments were especially useful in helping to gain the tool set for our various case studies.”
- “Very well organized and helpful. Labs are well planned out and helpful for the course.”
- “Nice Job!”
- “Great TA. Teaches the lab section well.”
- “Awesome! A++!”

**Lecturer Evaluations: A sample from Spring 2009, AOS 100, Introduction to Weather and Climate**

- “Very easy to follow and learn from. Great examples and enthusiasm.”
- “Very enthusiastic. Always encouraged questions and clearly wanted us to do well.”
- “Great Powerpoints and visuals. Lots of enthusiasm, very helpful and responsive.”
- “Her lectures were very organized which is extremely helpful. She was enthusiastic which makes paying attention easier. Clearly knows her stuff.”
- “Instruction was good, well planned out and enthusiastic”
- “Great Professor”
- “Very enthusiastic, visual aids very helpful, pictures of versatile weather kept it interesting.”
- “She was exciting to listen to.”
- “Great organization. Great lecture style, good pace.”
- “Andrea made the class very interesting and enjoyable. It was enjoyable to come to class. She really intrigued me with the material presented, stimulating my interests further – I really learned a lot.”
Statement of Teaching and Mentoring
Andrea Lang

Introduction

As the teaching assistant leading the lab section of an upper level synoptic meteorology course, I was intimately involved in the students' first exposure to research methods in the field of atmospheric sciences. My role was not only to be involved in teaching the basic scientific skill sets to enable students to do research, but also to enable them to create their own scientific questions, decide on pertinent cases studies, and set goals for their research projects. Although not my official title, my role was that of a teacher-mentor. In this untraditional, yet fulfilling classroom setting, I encouraged one-on-one dialogue with my students which allowed me to learn about their individual needs in the lab. Using my own experience and skills related to their interests, I provided guidance to set them on the right path toward creating and reaching their individual research goals. In this role, I was a facilitator who enabled student-centered learning in an engaging classroom setting and allowed them to grow both professionally, as atmospheric scientists, and personally, as their confidence in their ability to do research in the field improved.

Communicating science and the process of science effectively is an important aspect of the role of a university professor, from articulating the insights of new research to veterans of the discipline to constructively imparting core subject knowledge to non-science students. I have come to realize that it is in this area, the communication of science and its processes, that the seemingly separate realms of research and teaching are vastly intertwined. While working towards a Certificate in the Delta Program for Teaching, Research, and Learning and teaching at both the introductory and upper level, I have had the opportunity to reflect on the three Delta Pillars that are central to teaching and learning in a university setting. The first is the importance of using research methods to develop and implement teaching practices that advance the learning experiences and learning outcomes for both students and teachers. Second, is the idea that a community of learners will challenge its individual members in shared learning, discovery, and the generation of knowledge. Finally, the concept that learning is enhanced when the educational process capitalizes on diversity of backgrounds, experiences, and skills within a group. The following teaching and mentoring philosophies are my current, yet evolving, interpretations of methods to intertwine these core ideas in practice at a research university.

Teaching Philosophy

Teaching a university science course at any level involves much more than teaching students core subject matter, including how to analyze and question challenging topics, but also involves a concerted effort on behalf of the instructor to make the science approachable and accessible to all students. As an instructor I find exceptional value in embracing the intrinsic diversity of the students in a class by considering a wide variety in learning styles, background knowledge, and personal stories, while constructing course material. Now more than ever, the college classroom is evolving and trending away from traditional passive, lecture based courses. Engaging students in an
active learning process provides an opportunity, both inside and outside the classroom, for students to discuss the subject material with their peers as a community of learners. Courses in atmospheric science lend themselves to case studies, group work, and problem solving, which increases the role of the student-centered learning and is ideal for students with a variety of learning styles and backgrounds. This type of course material should be challenging, however, students should also be presented with the necessary tools to tackle these challenges with confidence. Providing students with specific learning objectives allows for a transparent yet concrete goal for expectations. In addition, these type of activities motivate students to identify with the material in a way that makes it approachable while emphasizing the the role of the teacher as the guide, facilitator, and mentor.

In both introductory and upper level courses, I have found that my most effective instructional tools have allowed me to enthusiastically incorporated subject material that ignited my personal scientific passions yet provided a number of real life examples and relevant activities that encouraged students to make the subject matter personal for themselves. Making the core science approachable and personal, in both the teaching and learning capacities, engages students in the material and is proven to greatly increases learning outcomes. Thus, it is something that I strive for in my current and future courses. Active learning activities can be elaborate, so as a new instructor I plan on starting simple, getting continuous feedback throughout the semester as to build toward a goal of an engaging, student-centered, inclusive classroom.

Accurately assessing what students have learned after engaging them with course materials is crucial aspect of improving my teaching methods and enhance student learning outcomes. Creating instructional material in steps, while asking pointed questions throughout the process aids in the breakdown of the teaching process into sections that become the focus of individual and critical scrutiny. What do I want students to know? What will be the most effective method to teach it? How will I assess their learning? Did this method work and how well? Determining where there is room for improvement is one of the keys to improving teaching, however determining how to improve your teaching is the process that takes time. This requires reflecting on each step of the teaching process and determining its overall impact on student learning. Communication is key to this teaching style, making myself an approachable teacher and mentor by encouraging questions, discussions, and feedback, I will continuously gain insight into the ways to improve my teaching for each unique class.

Mentoring Philosophy

At the heart of mentoring is teaching and learning, which is far from a passive process. As a research mentor, I believe it is important to initiate an active mentor-mentee relationship. By encouraging an open dialogue with my mentee from the beginning of our relationship, I set the stage as an accessible and approachable mentor. This not only engages my mentee, but it enables me to learn about their professional interests, skills in need of strengthening, and experiences. Engaging my students in a conversation will allow me to tailor my role as mentor to each individual. This will give way to discussions about opportunities I can provide for my mentee, including opportunities for improving research skills, setting professional goals, and increasing professional experiences, such as attendance to workshops or conferences. I believe mentoring is a two-way relationship centered
around learning and growth, both professionally and personally. As a mentor, whether in the classroom, lab, or research group, I also see myself providing a source of support that will increase the confidence for those I mentor. With time and experience, my methods of mentoring will evolve as I mature in my faculty position.

Each mentoring relationship will be different, as there will certainly be diversity in backgrounds and incoming knowledge for the students in my future research group. Embracing this diversity, by establishing a research group that promotes scientific discussion and appreciates the contributions of each of its members, will undoubtedly bring new and potentially fruitful perspectives to our research. Group meetings and informal or impromptu discussions will continuously provide a means by which the group as a whole can strengthen our communication of scientific questions and insights. This setting will provide guidance that enables those I work with to be informed in goal setting, research, and decision making. As my mentees develop and establish relevant skills and knowledge, they will gain confidence in their abilities and my role will be to strategically provide my mentees with increasing individual responsibility. During this evolution, I will continue to have an active role in the mentoring process of my future colleague, as one of the main roles of a research mentor is to actively engage a mentee in the environment, culture, and community of the science so that with time, they may become a fully participating member of the field.
Reflection

Teaching a large lecture while enrolled in “Teaching Large Lectures”
Incorporating active learning to engage a diverse group of students

During the Spring 2009 semester, I had the opportunity to teach as a hired Lecturer for the 200 person “Introduction to Weather and Climate” course in the Atmospheric and Oceanic Sciences Department (Supplement 1). In an effort to reflect on the issues and challenges that I would potentially face in teaching a large lecture, I concurrently enrolled in a Delta (Program for Teaching Research and Learning) course entitled “Teaching Large Lectures.” Enrolling in such a course also gave me a forum to discuss solutions or approaches to dealing with the issues I would face during my semester of teaching. I wanted to use this experience as a case study in the application of the Delta pillars (e.g. use research methods to evaluate teaching – pillar 1). By this point in my graduate career, I had taken a variety of Delta courses emphasizing the importance of student-centered learning, active learning, and engaging students in the classroom (e.g. creating learning communities – pillar 2 and learning though diversity – pillar 3) and I had also initiated the process of developing my own teaching philosophy. Thus, my goal was to integrate these active, engaging teaching methods in my instruction throughout the semester so that my large, lecture based course would involve a considerable component of student centered learning.

Pre- Large Lecture Reflection

While developing teaching materials for this course it was important for me to think about the intended audience. The diversity within the student body of any class is abundant. While I used to believe that diversity in the classroom merely referenced race and gender, I have come to realize that students not only come from diverse social and cultural backgrounds but also have a variety of preferred learning styles, communication methods, and begin classes with an array of different curricular abilities and strengths. I knew that designing course material so that the diversity within the classroom was used as a tool to convey knowledge was most likely going to benefit the overall learning process. By deliberately designing teaching materials to cater to a diverse audience, I was hoping to create a more equitable learning environment for all students. In an effort to effectively teach to my future diverse audience, I also took time to reflect on how my individual teaching style would best benefit these types of teaching materials. I believe that teaching should involve much more than just verbal lecture, as not all students learn by merely hearing information. Including visual or conceptual demonstrations along with an active component that engages students or relates material to real world examples would most likely increase the overall learning outcomes.

Large Lecture Teaching and Examples of Implementing of my Teaching Philosophies

At the beginning of every lecture, I set the stage for the rest of the period by engaging students in activities that related the course material to real world examples in what I called, the current weather discussion. I turned to the popular news websites for weather headlines from around the world, then would connect our course material to the real life examples. The processes of connecting the science to visual impacts and possible consequences allowed students to place the concepts from the course into the context of the world in which we live. In general, the end of the semester course evaluations had a very favorable view of this activity (although there are always those who say it was not tested so why teach it, something to reflect on for future versions of the course).
During my presentation of course material, I made an effort to enthusiastically present the information from a variety of perspectives to benefit a variety of preferred learning styles. For example, in addition to verbally communicating the concepts involved in heat transfer, I provided visual illustrations such as pictures and several videos of time lapse convection and advection in the atmosphere. I supplied the in class activities with tools for learning outside the classroom, by suggesting at home observational activities, web links, and YouTube videos that supplemented the classroom demonstrations (Supplement 1). Throughout the semester I would receive emails from students regarding YouTube videos they found while extending the in class activities, frequently the questions asked in those emails went beyond the course facts as students went on to apply what they had learned to observed phenomena. Encouraging this type of activity makes the course material personal to the students and I have found this to greatly increases learning outcomes. In future versions of the course I plan on focusing on the idea of applications of the course material, such as those emailed to me by students, in homework assignments.

Reflecting on teaching in a Large Lecture

Overall, I believe my first experience in teaching a large lecture went well and I certainly learned from my achievement as well as from my colleagues in the Delta courses. One of the biggest things I've learned is that it does take much more time that anticipated to create a good lecture. Budgeting time is key to getting presentations done efficiently. I also have learned that if you want students to talk or discuss during class, you have to get them to do so in the first 5 minutes of the class. Setting the tone for a lecture is very important, a sudden change in teaching styles generally isn't well received. Yet another thing I've discovered is that it is very hard to incorporate the breadth of information I've acquired about being an inclusive teacher, supporting multiple learning styles, using active learning in a large lecture. I have a conceptual understanding how these methods are suppose to work in a large lecture and have read about some good examples of using these methods in classes, but when it comes time to prepare your own lecture/class, it is much more difficult than it seems in writing. Knowing your own teaching strengths and weaknesses is a major part adapting to teaching in the most effective manner.

It was not until I taught in front of a large lecture for the first time, that I really started to get a feel for my own strengths and weaknesses. Reflecting upon them, I have realized that one of the things I should plan for during lectures, is pausing during lectures to ask more questions of my students. While I did give them opportunities to ask questions, I only ask questions of them at then end of teaching a concept, not in the middle. I realized I did not receive feedback from them frequently enough during any given lecture and doing so would have given me a better sense of where the students were in digesting the material and what concepts I needed to put more time into. Thus, one thing I will strive to do is incorporate more formative assessment into my teaching. Overall, I felt that I benefited greatly as lecturer and as a student discussing teaching with my peers in a course dedicated to improving teaching. My experience allowed me to critically reflect on my own teaching style and methods, so that with time I can improve my teaching to become a great instructor.
Reflection

Creating useful tips for a new TA

Teaching other teachers

As I walked into the classroom on the first day of my first TA experience, I remember thinking, “What I don't know an answer? What if I say something wrong? How will I fill up an hour? What if I forget something?” I remember feeling nervous and a little awkward as I made my way through the back door toward the front of the 30 student classroom. I tried to calmed by nerves as I quieted the class, day one was going to be a class wide discussion, a get to know you class, I wanted to encourage the open classroom environment. I wanted the class to become a community of learners, I wanted them to work together and speak up if they had a question and to actually ask questions during class, but I was still nervous, I really wanted everything to go perfectly.

I remember feeling overwhelmed preparing for my first TA experience. At that time, I looked up to the more experienced TAs in the department for advice. It was a relief to have someone to bounce ideas off of and to hear speak about their experiences, both good and bad. Having that dialogue with someone who had had a similar background was encouraging, knowing that I wasn't alone in my trepidation as a first time teacher was a bit revealing. This was a community after all, one that had diverse perspectives on TAing that helped me in my preparations. So after TAing Atmospheric and Oceanic Sciences courses for upwards of 6 semesters, and whole heartedly enjoying my interactions with students along the way, I also remember being asked by the department Chair to represent the experienced TAs by speaking to the new TAs about my own experiences. He wanted to provide them with advice and tips on what to expect during their first semester TAing, and make some suggestions on how to handle the new undertaking. I immediately said yes to this opportunity, remembering how the community of experienced TAs had helped me in the past.

This opportunity allowed me to reflect on my teaching experiences up to that point in my teaching career. What advice and tips would I want to pass along to new TAs? In my first interactions with them, what bit of information would have the biggest impact and why? Where will this advice fit into their larger teaching goals? As I look back on how I prepared for this opportunity to address the new TAs, I realize that I was preparing in the same way I prepare for any other teaching activity. While preparing materials I would ask myself, What do I want students to know? What will be the most effective method to teach it? Once I have an idea of how to answer those questions, I will be able to clearly state my intentions to my students. They should be able to answer questions, such as, why are we doing this activity? Where does this fit in to the broader course goals? What is expected of me by to complete this lesson? What am I suppose to learn? By being clear in my creation of teaching materials, I communicate the motivation and intention of my teaching tools. I've found that this approach is well received by my students, the goals are clear and they appreciate this effort on my end, so it was this approach that I used to address the new TAs.

I decided that since my first interaction with the new TAs was scheduled to occur prior to the first day of class, I would focus on providing advice that would be most useful during this stressful, sometimes nerve racking time. What can you to to be prepared on Day 1 of class? As I reflected on the advice that was most useful to me, I tried to incorporate my own experiences into explaining why it was useful. Before the first day of class, I decided to focus on the importance of construction
of a good syllabus. This not only helps you organize your thoughts on how the semester will proceed, it helps you create a plan of attack on certain topics. It helps you put your teaching material into the context of the course goals, it allow you and the students to see the bigger picture. By creating a detailed syllabus you are making your goals and expectations transparent to the students and it my experience this is appreciated by the students in the long run. If you run into a roadblock, ask for help if you need it, there is probably someone who has TAed the class before you and has copies of old labs, homeworks, or notes they would be willing to help you incorporate into your new class.

The next tip I decided to give the new TAs focused on the actual first day of class. Recalling my nervousness, I reflected on what pieces of advice would have benefited me in preparing for my first ever day of teaching. What came to mind first was a need for reassurance, with a well developed syllabus and a plan for the semester, the first day is about being confident and self assured, and creating a relationship with your new students. Part of feeling confident is feeling relaxed and being yourself, while this makes sense, sometimes hearing the advice from someone else is reassuring in itself. On day one you will want to create a mood in the classroom that you want to keep up for the rest of the semester, for yourself as a confident teacher and for the classroom environment. If you want active discussion in your classroom (e.g. a functioning learning community), set the stage on the first day of class. It will be hard to change the classroom dynamic later, once students have grown accustom to one expectation it will be hard to change it. Thus, you want to make sure you go over the syllabus, including the course rules and expectations. As one advisor once told me, “Its always easier to bend rules later in the semester than it is to enforce new rules after some time.”

On day one, I have found it important to make an effort to get to know my students. In fact, in course reviews, they have said that they appreciate the effort and it shows to some extent in the work they turn in later in the semester. Building a relationship with your students helps to create a two way dialogue that engages the students not only in the course material, but in the learning process by encouraging them to speak up when they have questions. On that note, it is also important to communicate openly with students, for example, it’s okay not to know the answer. You can always get back to a student once you’ve found an answer to their question. Communication is key in the classroom, explaining why students are doing what you want them to do and where it fits into the course goals will aid in teaching. This helps remind you why the activity is important and remind them of how this fits in the course goals.

While reflecting on creating the tips and advice for the new TAs, I created a one page handout “Useful tips for the TA” (Supplement 2). I decided that I would pass this out to the new TAs as a cheat sheet on TA tips, however, while presenting the information it contained I would be sure to relax and be myself. I wanted to communicate my experiences and put a context to the points I made. I also was sure to encourage a relaxed, open dialogue with the new TAs. I made my self available to contact throughout the semester. I not only wanted to communicate the tips for a successful TA experience but I wanted to lead by example.
Reflection
My Delta Internship Project
Realizing the need for student-centered, engaging teaching materials and putting them into practice

Commonly taken by undergraduates majoring in Atmospheric and Oceanic Sciences during their senior year, AOS 452 combines the dynamics, physics, and calculus that the students have learned in their prerequisite courses with a scientific discussion of the weather experienced by the middle latitudes of Earth. This course was my favorite as an undergraduate, it represented the weather in terms of elegant mathematical relationships that intrigued me as a young scientist and left a mark on my classmates as an important stepping stone in our diverse career paths in atmospheric science. Once in graduate school, I was asked to serve as the teaching assistant for the laboratory section of the course, I immediately stepped up to the opportunity. The laboratory section of AOS 452 was intense, the course was 4 credits meeting from 1:20 to 4:30 every Tuesday and Thursday. However, it was in the lab section that, as a student, you apply the concepts learned in lecture to a real world discussion of the variety of synoptic meteorological phenomena, my role as a TA would be to facilitate this learning in the lab (Supplement 3).

At the end of my first experience TAing AOS 452, I was hooked. While teaching the lab section, I was not only involved in helping students to grasp the complex course material, but also in teaching students the real world application of that material. Answering student questions not only helped them but also deepened my understanding of the course topics, some related to my own research. I enjoyed the hands on aspect of teaching in this capacity. I introduced students to labs and allowed them to work at their own pace, I made it my role to facilitate their learning on an individual basis. It was in this position that I quickly realized that I was not only a teacher, but also their mentor.

After three semesters of TAing and interacting with the students enrolled in AOS 452, I came to realize that though the course required students to complete a real world case study, there was not deliberate instruction on the development of relevant research methods. Thus, the performances on case studies have covered a wide scale, from excellent and well researched to poor, with little in the way of a developed research method. Anecdotally, this has resulted in students having uncertainties of their own research abilities as well as a muddled understanding of research methods in meteorology once the course is complete. I came to the conclusion that these materials need to be incorporated into the course content. I proposed a project to design, implement, and evaluate instructional materials aimed at teaching not only meteorological research methods but also course content in AOS 452, which would be tested during the fall 2009 semester. (See Supplement 3 for the details of the project.)

Being as transparent as possible in the communication of the purpose of the new lab material, as well as the purpose for the evaluation of the material was a key step in carrying out the Delta project. As the mini case studies rotations began, I was very clear in my communicating a student centered learning environment. From the beginning, the instructors introduced a case and encouraged a class wide discussion, setting the stage at the onset of the project that the class was taking on this task as a community of learners, to discuss their ideas openly as peers. The class wide discussion enabled students to create their own scientific questions. From there, students
began working in groups, in which I encouraged student centered learning by facilitating group discussions leading to a deeper conceptual understanding of case material. I made myself available to the students, both in and outside the classroom, but I encouraged them to use their group members to discuss potential case study ideas. After developing their ideas, the students engaged themselves actively in the lab, working in groups and when applicable shared processes while working on their own projects. The students were very supportive of the whole process which was aimed at helping them fulfill their course requirements. I would characterized the project as a success.

My time in the lab with students not only helped them succeed in the their case study work, but it helped me become a more effective teacher-mentor. My interactions and communication with the students was invaluable. While I facilitated their work throughout the semester, I also gained exceptional insight into the level of understanding, progress, and mood of the students in the lab. In addition, I got to know my students, interacting with them for several hours a week motivated me to push them to succeed. From this interaction, I realized my own strengths and weaknesses in communicating the complex ideas related to the lab. Each interaction I would reflect, conjuring up a more effective way of conveying complex the information. The formative assessment in the lab help me plan my upcoming lab activities and schedule geared toward maximizing their learning outcomes. The student feedback on the lab evaluations revealed that they supported the communication and appreciated my formative evaluations.

Upon completion of the Delta Project, I gathered the feedback on the project and discussed its implementation with the course professor. We both agreed that the project was such a success, that the mini case study work would become a part of the course in the future. Apparent from the final case study projects, student learning outcomes were increased. However, students did relay their concern for the increase in coursework related to the project. Student feedback is one of my considerations in the reimplementation of course materials, so in the future, perhaps a decrease in the number of mini case studies or in the requirements will be needed.
Supplement 1: AOS 100, Introduction to Weather and Climate Teaching Tools

Found at www.aos.wisc.edu/~aalopez/aos100.html

This website was created and designed by me for my section of Introduction to Weather and Climate. The purpose of this design was to allow students to have an accessible and central location for course related materials and suggested extracurricular content, including links to course related YouTube videos, interesting satellite images, and web based applets to encourage learning outside the classroom. Likewise, this site contained homework, homework solutions, the course syllabus and schedule, and course notes.
Engaging students in the classroom

In an effort to engage students both in and out of the AOS 100 classroom I asked them to take pictures of interesting weather phenomena they had experienced throughout the semester, with then goal of using these student photos in my discussion of course material.

One students submitted this photo (right) asking how this pine tree became coated in frost on all sides of the needles, I in turn used this in my discussion of freezing fog.

Two different students submitted the photos below (left) and (right), which I used in my discussion of thunderstorm development.

In class exercises for the students in a large lecture to do in small groups. During lectures I would allow for students to think about the recently covered material and encourage them to interact with their classmates to solve problems, then encourage a classroom discussion to work toward the solution. The examples on the next page are from the section of the AOS 100 course covering condensation and evaporation.
Condensation and Evaporation

What is going on inside this cup?

Why do the sides of the cup appear wet?

Think about...
Condensation
Evaporation
Water vapor content of the air

Example: A foggy bathroom

When you enter your bathroom the air is _______ (saturated/unsaturated)

Turning on the shower brings the air closer to saturation by _______
(1) _______
(1) adding water to the air
(2) cooling the air

After several minutes a fog forms, what happened?

The air reached saturation

So how does the fog form in the air?
Supplement 2: AOS TA training handout

Useful Tips for the TA

1. Before class begins, create/review the syllabus for your class. Having a good idea of what the semester holds will keep you on top of things on the first day of class.
   ● Does it have the information about who you are, where they can find you, the time/locations of your office hours, your email, and the address of a course webpage (if there is one)?
   ● Does it give the students an idea about what they will cover, how their grade is determined, and the course rules? They will want to know this information.

2. The first few days of class.
   ● Relax and be yourself.
   ● Create a mood in the classroom that you want to keep up for the rest of the semester. If you want active discussions, set the stage on the first day of class. It will be hard to change the classroom dynamic later.
   ● Get to know your students, they appreciate the effort and it will probably show in the work they turn in. Use name tags if you need to, call roll for the first several classes, talk to them.
   ● Set the course rules and go over them with your students. It's always easier to bend rules later in the semester than it is to enforce new rules after some time.
   ● Go over the syllabus, all the important information should be there (grading policy/due dates/exam dates/accessibility info...) so later they can't say “I didn't know...”

3. Teaching tips
   ● It's okay not to know the answer. You can always get back to a student once you've found an answer.
   ● Ask for help if you need it, there is probably someone who has TA-ed the class before you and has copies of old labs, homeworks, or notes they would be willing to share.
   ● Be organized, have a plan for each class.
   ● Return student work promptly, they will appreciate it and they (and you) will know what they need to review giving you feedback on student learning.
   ● Hold office hours and stick to them, it is okay to not be available all the time.
   ● Communication is key, explain why they are doing what you want them to do and why. This helps remind you why the activity is important and remind them of how this fits in the course goals.
Supplement 3: My Delta Internship Project Report
Adapting an upper level Synoptic Meteorology course to teach meteorological research methods

Introduction
Undergraduates students graduating with a degree in Atmospheric and Oceanic Sciences (AOS) at the University of Wisconsin-Madison commonly take AOS 452 during the fall semester of their senior year. The course, which averages roughly 20 to 25 students, combines the dynamics, physics, and calculus that the students have learned in their prerequisite courses with a scientific discussion of the weather experienced by the middle latitudes of Earth. The course is also usually required in the pursuit of several career paths, such as those in broadcast meteorology and in operational meteorology. In previous years, the final project for the course has been a case study assignment. Students select a significant midlatitude weather event and use the tools they have learned throughout the semester to diagnose several aspects of the evolution of their particular case. However, with no deliberate instruction on the development of relevant research methods, the performances on case studies have covered a wide scale, from excellent and well researched to poor, with little in the way of a developed research method. Anecdotally, this has resulted in students having uncertainties of their own research abilities as well as a muddled understanding of research methods in meteorology once the course is complete. The purpose of this project is to design, implement, and evaluate instructional materials that are aimed at teaching not only meteorological research methods but also course content in AOS 452 during the fall 2009 semester.

Background
Teaching via research activities in undergraduate courses is not a new idea, the higher education research literature contains numerous studies citing the importance of promoting the links between the activities of teaching and research (i.e. Boyer, 1990; Hattie and Marsh, 1996; Jenkins, 2000; Elton, 2001; Stewart and Rudolph, 2001; Brew, 2003a,b; Holbrook and Devonshire, 2005). The idea of using research as a tool for teaching stems from the concept that engaging students in scientific problem solving will expose them to deeper understanding of various conceptions of the natural world, as well as provide an opportunity for them to develop greater insight in the practice of science in its various forms (Stewart and Rudolph, 2001). In short, the instructor facilitates learning by emphasizing the construction of new knowledge during the research process. Brew (2003b) coined the term research-led teaching based on this process and broke it down into three general categories, which were later labeled by Holbrook and Devonshire (2005). First, research-informed teaching is the idea that teaching methods draw on discipline based research. Second, research-skills teaching develops student research skills. Finally, research-inquiry teaching is the concept that teaching via research is followed by the investigation of the effectiveness of the learning activities and student learning as a whole. The project proposed here will contain all three categories of research-led teaching.

The benefits of research-led teaching in the earth sciences have been documented as well. Jenkins (2000) argued that, with respect to the field of geography, a research-informed and research-skilled curriculum is imperative. He described that it not only enables students to experience the research process but it also develops research skills that enhance their capacity to make a contribution to the discipline-based research. In climate science, a sub-discipline of atmospheric science and closely related to the discipline of our project, Holbrook and Devonshire (2005) have used the research-led teaching approach to develop an engaging learning activity for third-year
geography students that simulated scientific thinking and unveiled the complexities of climatic processes. They use climate models to quickly and cleanly visualize and animate massive amounts of data, something that is routinely used in climate research. During this activity the conceptual models that the students had learned throughout the course provided a framework for understanding the complex concepts and processes illustrated in the model. The analysis of model data provided an accessible foundation for actively engaging students in the mathematics and physics behind their analysis. They justified the development of their laboratory practical by stating that their research-led teaching exercise encouraged deep approaches to learning because the activities were relevant and tangible to students career aspirations, typically more interesting and engaging, and more likely to be intellectually challenging.

Methods

The instructional materials that will be developed for the AOS 452 course will be of the same nature as those used in the climate science course outlined by Holbrook and Devonshire (2005). Using the same numerical model data used by atmospheric scientists, students will use a research approach to apply their fundamental and conceptual knowledge to achieve a variety of learning goals. After the first quarter of the course, once fundamental knowledge is established, the new institutional materials and activities will be integrated. This will consist of a two week case study period.

The first class of the two week period will be facilitated by the instructors and the class will interrogate a specific aspect of recent weather event using discipline specific research tools (i.e. the analysis time of numerical model data, the Gempak software...) during a 30 minute class wide weather discussion. During the class discussion, the instructors will guide the students through the research process: developing a research question, establishing a method of analysis, experimentation and work product, conducting the analysis, and answering the initial question with a scientific deduction or diagnosis. In the past the classroom has been very open to student participation in similar discussions, an aspect of the course that is beneficial to developing a learning community, that incorporates the whole class, where all students gain from the topics being discussed. Likewise, the instructors will also initiate inquiry into other aspects of the weather event which will lead into the student research projects. They will be given the option to answer of one of 3-5 of mini case study questions, where they will need to research another aspect of this real world case.

<table>
<thead>
<tr>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class wide weather discussion</td>
<td>Class wide discussion</td>
</tr>
<tr>
<td>- Facilitated by instructors</td>
<td>- Develop other research questions for case</td>
</tr>
<tr>
<td>Class will interrogate a specific aspect of recent weather event</td>
<td>- Assign questions to students as mini case studies</td>
</tr>
<tr>
<td>- Use of discipline specific research tools</td>
<td>- Provide feedback on questions</td>
</tr>
<tr>
<td>Guide the students through the research process</td>
<td>Mini Case Questions Due</td>
</tr>
<tr>
<td>Work day</td>
<td>Discuss the process/results of research</td>
</tr>
<tr>
<td>(and regular course lab)</td>
<td>Handout survey/questionnaire</td>
</tr>
</tbody>
</table>

Table 1: A summary of the AOS 452 laboratory schedule specific to integrating the two week mini case study projects into the regularly scheduled lab activities.
They will have the remainder of the two week period to follow the presented research method and diagnose the characteristics of a particular aspect of the weather event. At the end of the period, the mini case study analysis will be turned in and the process will start over with a new weather event. Over the course of the semester, the students will have roughly 2 mini case studies in preparation for their final case study. A summary of this timeline is shown in Table 1.

**Assessment**

During the fall 2009 semester of AOS 452, the students completed two mini case study projects in preparation for their final individual case study assignment. At the completion of each two week period, the students submitted their mini case study write ups for grading. Students were not only assessed for their conceptual understanding communicated in their write ups, but also their aptitude and ingenuity in their research design. The write ups were graded by the course professor, Dr. Jonathan Martin, as he also graded the final case study assignments. His written comments and scores out of 100 for the mini case studies were recorded and described in the Results section.

While the main purpose of this project was to teach meteorological research methods to students in AOS 452, second goal was to increase student confidence in their ability to carry out and succeed in individual research projects. In an effort to measure student confidence and interpretations of research methods, the students were given anonymous surveys throughout the semester. Though the surveys were anonymous, students had unique three digit IDs only identifiable to them, so that an individual's survey responses could be tracked throughout the semester. The surveys (Appendix 1) were administered at three different periods during the semester: first (1), weeks into the semester, second (2), after the first two mini-case studies, and third (3), as they work on their individual cases. The responses to these surveys have been compiled in the Results section.

**Results**

The surveys were a combination of open ended and scaled questions. Survey 1 (see Appendix 1) was administered roughly three and a half weeks into the semester, once students had adjusted to the course style and workload. The results were generally what one would expect from students with little background knowledge of meteorological research methods. Almost all the students in the laboratory (15/19) responded “no” to the question “if given an individual case study assignment today, would you know how to begin your case study research?” (Fig. 1) Of those who responded “no,” the top three reasons given were lack of direction, lack of information on the process, and lack of prior experience (Table 2). Consistent with these results, the students expressed a lack of confidence in their ability to carry out a case study project three weeks into the semester. On a scale of 1 to 10, with 10 being very confident and 1 being not at all confident, the average response to the question regarding confidence in choosing an individual case study topic was 4.8, with a standard deviation of 1.8 (Fig. 2). In general, the student expressed lacking the knowledge of the case study process and a relative lack of confidence
in their ability to choose a topic for the case study process.

Table 2: Results from survey 1. The students that responded “no” to question 1 were asked to explain their response, these could be broken down into 4 response categories. Percentages of those who gave this response are given in reference to those who answered no and the class as a whole.

<table>
<thead>
<tr>
<th>Response Categories</th>
<th># of responses</th>
<th>% of NOs</th>
<th>% of class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of direction</td>
<td>12</td>
<td>80.0%</td>
<td>63.2%</td>
</tr>
<tr>
<td>No info on the process</td>
<td>4</td>
<td>26.7%</td>
<td>21.1%</td>
</tr>
<tr>
<td>No prior experience</td>
<td>3</td>
<td>20.0%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Lack of confidence</td>
<td>2</td>
<td>13.3%</td>
<td>10.50%</td>
</tr>
</tbody>
</table>

The second survey was administered after students were exposed to the first two mini case study projects (see Append. 2). At this point in previous semesters, students would not have had any exposure to case study research methods, they would only have the related tools gained in their laboratory work and lecture activities. Anecdotally, this students involved in the mini case study projects this particular semester were very happy that they had the opportunities to get feedback methods and write-ups prior to completing their group case study project. When asked “if given an individual case study assignment today, would you know how to begin your case study research?” (Fig. 1), 18 out of 19 students responded “yes.” When asked to elaborate on their responses, they gave specific examples of tasks to be completed in order to carry out a meteorological case study (Table 3).

Table 3: Results from survey 2. The students that responded “yes” to question 1 were asked to explain their response, these could be broken down into 6 response categories. Percentages of those who gave this response are given in reference to those who answered yes and the class as a whole.

<table>
<thead>
<tr>
<th>Response Categories</th>
<th># of responses</th>
<th>% of YES</th>
<th>% of class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply diagnostic tools</td>
<td>11</td>
<td>61.1%</td>
<td>57.9%</td>
</tr>
<tr>
<td>Synoptic overview</td>
<td>10</td>
<td>55.6%</td>
<td>52.6%</td>
</tr>
<tr>
<td>Use visual. software</td>
<td>3</td>
<td>16.7%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Use past experience</td>
<td>3</td>
<td>16.7%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Read literature</td>
<td>2</td>
<td>11.1%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Lack of confidence</td>
<td>2</td>
<td>11.1%</td>
<td>10.5%</td>
</tr>
</tbody>
</table>

Overall, the responses were on target with the expectations of the mini case study projects. Students could identify steps in completing a case study and were using the mini case study projects as a source of information. After students had completed their mini case study projects, their confidence in their ability to develop research topics for individual projects increase dramatically (Fig. 3). On the same 1 to 10 scale, student confidence increased to an average of 6.7, with a standard deviation of 1.2. In addition, their confidence in their ability to use the scientific knowledge in their case study assignments grew. When students were asked to rank on a scale of 1 to 10 “how confident would you be in your ability to diagnose the physical mechanisms that are responsible for a specific synoptic scale weather event?” their answers averaged to 7.2. Not only were they more knowledgeable about the case study process, but their confidence in their abilities to take on the task had grown.
The assessment of the mini case study write-ups was done by the lecture professor for the course. His comments were recorded for each group, then compared between groups for overarching themes. After this was done for each mini case study, trends in comments from the first case to the last were examined. The first mini cases study revealed that students were lacking understanding of how a research document was organized and written. Comments in this category generally suggested that student review a handful of accessible and relevant papers from the scientific literature and note the style of citations, figures, and overall structure. Comments also suggested that more explicit detail of examples and connections made in the writeup be elaborated upon in future work. By the second mini case study students had much more polished and comprehensive writeups. The comments still reflected that students become familiar with the style of meteorological scientific literature, and suggested locations to do so, however, the feedback was much more specific and written to students at a higher level. The professor made sure to tell his students that as he passed back their assignments.

The third survey was administered while students were working on their individual case study projects. It was at this time, that student were under the stress to create their own research questions, develop their own informed research methods, and write about their individual results. At this time, we had fewer responses submitted to work with, however, they are included and analyzed. When asked, “Now that you are working on your individual case study assignment, did you know how to begin your case study research?” all but one respondent (14/15) answered “yes.” The “no” response elaborated in question 2, by saying that all the tools were available to them, but they never practiced developing their own, not group, research questions. When the “yes” respondents expanded their answers in question 2, they gave specific examples similar to the results in Survey 2 (see Table 3). Students were applying what they had learned from the mini case study assignments to their individual research projects. As they worked on their individual cases studies, they not only had a high level of confidence (averaging 7.13 on the 1 to 10 scale) in their ability to develop a
research question for their cases, they also were confident (8.13 on the 1 to 10 scale) in their scientific ability to diagnose the specific meteorological processes in their case. The results of the students' individual case study projects, as reported by the professor who taught the course for 15 years, were very much improved from previous years. Anecdotally, the “students wrote at a higher level” and “these are comments I would give a first year grad students” were two descriptions from the case study grader.

**Summary**

Many undergraduate students majoring in Atmospheric and Oceanic Science at the University of Wisconsin-Madison take AOS 452 during their senior year. The final project for this class is an individual case study assignment in which students are to develop their own research question, create their own method to solve that question, and write their results in the fashion of the relevant scientific literature. Previously, student were assigned this task with no deliberate instruction on the development of relevant research methods. Anecdotally, this has resulted in a wide range of scores (from very poor and uninformed to excellent well written pieces of science) as well as students having uncertainties of their own research abilities and a muddled understanding of research methods in meteorology once the course was complete. The goal of this project was to design, implement, and evaluate instructional materials relevant to teaching meteorological research methods to students in AOS 452. The two week rotation of mini case study projects that were developed to fulfill this goal were a success. Students were not only more informed about the process of conducting meteorological research, but their confidence in their ability to do so successfully increased. This resulted in higher achievement on their final individual case studies and a higher level of understanding in many of the course concepts. Though these projects were intensive, they will be used again in future offerings of the course.

**Cited Literature**


Appendix 1: Delta Internship Project Survey Questions

Survey 1: Administered early in the semester

Please answer the questions honestly and as descriptively as possible.

1. If given an individual case study assignment today, would you know how to begin your case study research?

Circle one: Yes No

Please give a brief explanation of your response:

2. To the best of your knowledge, please give an overview of the steps in the meteorological research process.

3. How confident are you in your ability to develop a topic for research inquiry for future case study/research assignments?

Not at all Very
Confident 1 2 3 4 5 6 7 8 9 10 Confident

Please give a brief explanation of your response:

4. At the beginning of AOS 452, how confident would you be in your ability to diagnose the physical mechanisms that are responsible for a specific synoptic scale weather event?

Not at all Very
Confident 1 2 3 4 5 6 7 8 9 10 Confident

Please give a brief explanation of your response:

5. After you leave AOS 452 in December, what skills do you hope to have learned in this class?

...
Survey 2: After the two mini case study projects

Please answer the questions honestly and as descriptively as possible.

1. If given an individual case study assignment today, would you know how to begin your case study research?
   
   Circle one:  Yes  No

   Please give a brief explanation of your response:
   
   .
   .
   .

2. To the best of your knowledge, please give an overview of the steps in the meteorological research process.
   
   .
   .
   .

3. How confident are you in your ability to develop your own topic for research inquiry for future case study/research assignments?

   Not at all 1 2 3 4 5 6 7 8 9 10 Very Confident

   Please give a brief explanation of your response:
   
   .
   .

4. Now in the middle of AOS 452, how confident would you be in your ability to diagnose the physical mechanisms that are responsible for a specific synoptic scale weather event?

   Not at all 1 2 3 4 5 6 7 8 9 10 Very Confident

   Please give a brief explanation of your response:
   
   .
   .

5. What aspects of the mini case study projects have played a role in how you answered the previous questions?

   .
   .
   .
Survey 3: While working on their individual case study projects

1. Now that you are working on your individual case study assignment, did you know how to begin your case study research?

Circle one: Yes No

Please give a brief explanation of your response:

2. Please list the steps you have taken or plan to take during your synoptic case study research process?

3. How confident are you with your topic for your case study research?

Not at all 1 2 3 4 5 6 7 8 9 10 Very Confident

Please give a brief explanation of your response:

4. Now toward the end of AOS 452, how confident are you in your ability to diagnose the physical mechanisms that are responsible for a specific synoptic scale weather event?

Not at all 1 2 3 4 5 6 7 8 9 10 Very Confident

Please give a brief explanation of your response:

5. The mini case studies will be used again next year, please describe one aspect you would not change and one aspect that could use improvement?