Competency: Advanced Writing in the Major

Educational experiences that satisfy the Advanced Writing competency in the major will provide students with sustained practice in increasingly sophisticated writing, in a variety of formats appropriate to the discipline. Faculty will guide students toward writing effectively in the discipline by providing appropriate evaluation of written documents, including opportunities to incorporate feedback and progress as writers, either through revision or subsequent assignments. Students’ coursework will also convey knowledge of and access to the necessary tools and resources for writing in the discipline.

Part 1: In the text box below, briefly describe (in about one paragraph), and in language suited to an audience composed of colleagues who are not specialists in your field, what it means to be competent in advanced writing at the undergraduate level in the discipline(s) appropriate to the major. *The text boxes in this form will expand as you type.*

The competent writer has a well-defined purpose and intended audience. Competency implies a good command of sentence structure, grammar, word choice, spelling, and punctuation that is consistent with the purpose and audience. As a technical discipline, competency for advanced writing is characterized foremost by the ability to present ideas clearly, precisely, and concisely. Conclusions need to be substantiated with supporting evidence, development of thought must be logical, and sources need to be carefully attributed and documented. A competent writer is able to incorporate the use of figures and tables to support and streamline the narrative. The writer will evaluate and rework drafts cognizant of the intended audience and purpose. The writer can critically discern the appropriateness of outside feedback on content and mechanics and revise accordingly in response to that feedback.

Part 2: Please briefly describe how your major curriculum meets each one of the learning objectives for Advanced Writing. Please attach a description of major requirements, sample syllabi, and any other relevant materials as appendices to this document.

Students completing educational experiences that satisfy the Advanced Writing competency as part of the requirements for graduation in the major will:
1. demonstrate increasingly sophisticated writing according to the conventions of their academic discipline;

Among the required courses, students begin with writing lab reports for PHY145, and then in the introductory atmospheric science course ATM210, write on topics within the discipline in both non-technical and technical forms. In ATM211, students interpret information for the purpose of writing weather forecasts. Among elective courses in the major, ATM327 and ATM335 (nearly all majors take one of 327 or 335 to satisfy National Weather Service requirements) require writing projects that incorporate use of data and quantitation. Students in the synoptic meteorology sequence (ATM311, ATM400, and ATM401) progress from writing weather forecasts, to analysis of major weather events, to research projects, the latter of which give students an introduction to a career in atmospheric science research. Nearly all majors elect this sequence of courses since the topic is the primary reason they have chosen the major.

2. be able to communicate clearly in writing, employing fundamental rules of usage, style, and mechanics in the context of their discipline;

The writing tasks described above demand clear written communication. Students also use these skills in many homework exercises and exams throughout the curriculum. Although mathematical derivations and quantitative problem solving are an important component, another purpose is to reinforce and evaluate the students’ understanding and application of concepts, so students must be able to provide understandable explanations or descriptions in response to exam or homework questions as well.

3. be able to evaluate critically a variety of appropriate written texts, including their own;

Students evaluate articles in the published literature in the process of selecting sources for writing projects. They must decide on the reliability and relevance of these written sources to their project. In some courses (e.g. ATM301, ATM400, ATM401), articles are assigned reading with the objective of being fodder for in-class discussion or for consideration in homework assignments. These exercises generally focus on evaluation of content. The dimension of style and mechanics is added when students participate in reviews to provide constructive criticism of peer writing as in ATM210. Students are strongly encouraged to be introspective of their own writing and taught the importance of critically evaluating their own work, before submission, by putting themselves in the position of the reader. This is a crucial aspect of the next learning objective.

4. demonstrate the ability to incorporate critical feedback on their writing, coming to understand that revision and rewriting are an integral part of the writing process.

Students incorporate both written and oral feedback on their writing through formal resubmission (e.g. ATM210) or by consideration of feedback from earlier assignments in the semester for subsequent assignments (e.g. ATM211 with forecasts and ATM400 and 401 with research projects). In ATM210, students are required to provide a resubmission cover letter that describes the nature of their revisions. Feedback is also given in the early
stages of the writing process through the requirement of project proposals (ATM335) or preliminary thesis statements (ATM210). Being lead through the writing process early in the major curriculum, students are able to demonstrate their independent incorporation of these writing habits with more advanced writing projects later in the curriculum with the 400-level courses.
Competency: Oral Discourse

Oral discourse provides opportunities for students to develop the oral communication skills they need to participate more effectively in public and academic debates and discussions. Each academic major will offer opportunities for students to participate in a variety of communication contexts appropriate to the discipline, and to reflect on the principles and theories relevant to specific oral communication activities.

Part 1: In the text box below, briefly describe (in about one paragraph), and in language suited to an audience composed of colleagues who are not specialists in your field, what it means to be competent in oral discourse at the undergraduate level in the discipline(s) appropriate to the major. *The text boxes in this form will expand as you type.

Graduates with a B.S. degree in atmospheric science should be able to comfortably pose and test a hypothesis in a group setting in an environment that facilitates discussion. Involved in this process is a discussion of relevant literature, and the organization of a complete “story” (i.e., a clear introduction, outline, review, analysis, and summary). Oral communication is an incredibly important aspect of being any scientist, whether it is communicating to politicians, as a consultant, or as a forecaster. Thus, students in the B.S. program in atmospheric science also present weather and forecast discussions in a small group setting, so as to receive questions and dissenting opinions from the audience. Finally, a valuable aspect of learning complex quantitative material is to teach it to a group, so our students are also expected to summarize key concepts taught in previous lectures in order to better understand the material, and to distill it into its principal components.

Part 2: Please briefly describe how your major curriculum meets each one of the learning objectives for Oral Discourse. Please attach a description of major requirements, sample syllabi, and any other relevant materials as appendices to this document.

Students completing educational experiences that satisfy the Oral Discourse competency as part of the requirements for graduation in the major will:

1. communicate ideas effectively appropriate to a specific context and according to a specific set of criteria;
The atmospheric “dynamics” sequence (ATM 316, 317, 418) is a required part of the curriculum and begins during the fall semester of a major’s junior year. In each course, students in groups of two are required to present a summary of the previous lecture, addressing the key points and using real-world examples when relevant. This activity teaches students how to effectively communicate complex, quantitative material and work it in to a conceptual framework. Additionally, students are required to do a complex study of a major weather (or climate) event in ATM 400 and 401 and present their study at the end of the semester in front of class. Students, through practice and guidance, learn how to manage a good pace, keep organized, and “tell a story” when giving an oral presentation.

2. establish and maintain an appropriate performer/audience relationship in a given oral exercise, and actively engage with listeners/audience;

In the aforementioned three-semester “atmospheric dynamics sequence”, students are required to critique their peers’ lecture summaries, taking note of how well the material was communicated to them, and offering constructive criticism. In the discussion section of ATM 311 (Severe and Hazardous Weather and Forecast), an elective that is taken by every atmospheric science major (in the past five years, every graduate has taken this course), students are required to present two hour-long weather and forecast discussions during the semester. These are done informally, so that the other students in the discussion can actively contribute by commenting on the weather maps shown, talking about their own forecasts, etc. In some cases there are major disagreements in the interpretation of the analysis or forecast maps, which often turn into lively discussions among the students. Students not presenting are graded on participation, to encourage the entire class to be involved. These weather and forecast discussions continue in the synoptic meteorology sequence (ATM 400 and 401), again taken by the vast majority of atmospheric science majors.

3. respond to, and where appropriate, incorporate listener’s comments and questions;

The open, informal nature of the once-per-week, hour-long ATM 311 discussion sections allow students to lead weather and forecast discussions while getting feedback, ideas, and criticism from the audience. As an example, a student might cite a certain explanation for the development of a major northeast snowstorm, but other students may have looked at different forecast data and come up with a different solution. This will often turn into a lively discussion that allows the class to come up with their own solution as a group. This type of oral discourse is highly relevant for students pursuing a career in operational meteorology (and in the private sector), as meteorologists often have to come to a quick decision in a group situation. Thus, it’s important to be able to have confidence to voice your own opinion, but also to know when to listen to others.
4. evaluate, orally or in writing, an oral performance;

As previously mentioned, students are required to summarize the last lecture’s material in front of class every lecture in the three-course dynamics sequence (ATM 316, 317 and 418). During each presentation, students are asked to critique and grade their classmates, as well as provide direct feedback during class. Through both presenting and evaluating over the course of three semesters, students master how to evaluate their peers’ presentations, organize a summary of key points, and teach complex material.

5. regularly practice communication skills through questions, discussions, debates and/or presentations (both formal and informal).

Students in the atmospheric science B.S. program are regularly exposed to group discussions in the synoptic meteorology sequence of courses (ATM 311, 400 and 401). Discussion participation is a part of their final grade, so students must contribute to the discussion, which in many cases turns into a debate as students defend their analyses and/or forecasts. More formal presentations are also a large part of the curriculum, namely in the required courses ATM 316, 317 and 418 (the dynamics sequence), and ATM 425 (physical meteorology), and the elective courses ATM 400 and 401 (case studies in the synoptic meteorology sequence). Thus, by graduation students have been exposed to many different types of oral communication as: 1) active discussion participants; 2) discussion leaders; and 3) research or analysis presentations.
Competency: Information Literacy

Information literate individuals are able to gather, evaluate, use, manage, synthesize, and create information and data in an ethical manner. They also understand the dynamic environment in which information and data are created, handled, and enhanced. Students demonstrate information literacy through finding information from appropriate sources; evaluating, using and managing information; and appreciating the role of information literacy in learning. Learning is understood here as the constant search for meaning by acquiring information, reflecting on and engaging with it, and actively applying it in multiple contexts. To this end, each academic major will offer increasingly sophisticated research assignments that rely upon diverse information sources. Students will find, process, evaluate, and cite information sources, creating and sharing information presented in multiple formats from multiple sources in a form appropriate to the discipline.

Part 1: In the text box below, briefly describe (in about one paragraph), and in language suited to an audience composed of colleagues who are not specialists in your field, what it means to be competent in information literacy at the undergraduate level in the discipline(s) appropriate to the major. *The text boxes in this form will expand as you type.

Graduates with a B.S. degree in atmospheric science should be able to both analyze meteorological datasets and investigate relevant literature in order to answer fundamental questions about a particular weather or climate problem. Much of atmospheric science is knowing where to look for meteorological or climatological datasets, how to work with them, and ultimately create publication-quality graphics using them. From an operational standpoint, our graduates should also be able to prepare a weather forecast using current and model data. Thus, students should be proficient in knowing where to retrieve different types of current and model simulation weather data (e.g., radar and satellite, airport and weather balloon observations, high resolution and global model runs), and in understanding how to use it to create a forecast. There is an overwhelming amount of meteorological data available to the public, so understanding which datasets are most pertinent in creating a timely forecast is deemed a necessary skill for our graduates.

Part 2: Please briefly describe how your major curriculum meets each one of the learning objectives for Information Literacy. Please attach a description of major requirements, sample syllabi, and any other relevant materials as appendices to this document.
Students completing educational experiences that satisfy the Information Literacy competency as part of the requirements for graduation in the major will:

1. understand the information environment and information needs in the discipline in today’s society, including the organization of and access to information, and select the most appropriate strategies, search tools, and resources for each unique information need;

   The Atmospheric Science B.S. curriculum requires students to take ATM 209 (Weather Workshop), ATM 211 (Weather Analysis and Forecasting, 4 credits) and ATM 350 (Meteorological Datasets and Numeric Computation, 2 credits) during a student’s sophomore and junior year. In ATM 209 and 211, students learn how meteorological data is acquired (radar, satellite, and surface and upper air observations) and disseminated to the public and government. In ATM 211, students are taught how weather models are created and run. Finally, students are also shown how to access this data, through both the web and locally stored data repositories. Many of the weather links used in class can be found on the course website, the link of which is in the syllabus. ATM 350 is taken during the spring semester of an atmospheric science major’s junior year, and in this class methods of data acquisition and display are taught. Students learn how to access meteorological datasets that can be found worldwide, and then create graphics that can be used by any other user in the world. Students also use meteorological graphics software to create their own plots. After students have completed these three required courses, they will understand how weather and climate data is observed, disseminated, and used for operations (forecasting) and research/analysis. These skills are relevant for any career path in atmospheric science.

2. demonstrate the ability to evaluate content, including dynamic, online content if appropriate;

   In ATM 211, students are required to participate in a local weather forecast contest for multiple cities around the country. The contest begins after students have been taught how weather data is observed and disseminated. They learn how to access this information through academic and government meteorological websites. Throughout ATM 211, the students also learn how and when this data should be used, so students develop a good understanding of how even though there is a plethora of meteorological data available, one must be careful about when and how to use the data.

3. conduct ethical practices in the use of information, in ways that demonstrate awareness of issues of intellectual property and personal privacy in changing technology environments;

   Students are often exposed to datasets from research and field campaigns that are proprietary; they can be shown by faculty, but not given to use by the students. Many elective courses taken by students (e.g., ATM 400, 401) require the use of meteorology literature, so students are taught to appropriately cite peer-reviewed work, as well as how to summarize key points rather than directly quoting articles. In ATM 350, as previously mentioned, students learn how to access datasets and graphics from around the world, some of which are restricted for public use. Thus, students are always learning which
types of meteorological data and analyses are freely available and which are restricted. By graduation, students will have written multiple research papers, in elective courses such as ATM327, 335, 400, and 401 (essentially every atmospheric science major takes one or more of these courses), and thus have effectively learned how to perform background literature reviews and cite articles when appropriate.

4. produce, share, and evaluate information in a variety of participatory environments;

In ATM 350, using all of the skills learned in class (and previous classes), students are to choose any recent major weather event and do a brief, but thorough analysis of the case and present it in front of class. The vast majority of students choose to take the synoptic sequence of classes (ATM 400 and 401), and more in-depth research projects are written and presented in both classes. Students must first do a literature review by perusing articles on the American Meteorological Society website (or other international science publishers), discuss relevant literature in a paper and presentation, and perform their own analysis on a case. Although it is an elective course, all atmospheric science majors choose to take ATM 311 (Severe and Hazardous Weather). In the discussion section of this course, students participate in a mock “storm chase”, where they are given a large amount of data and are required to choose, as a group, a location where they think tornadoes are most likely. Then, as the data changes in real time, they must alter their path accordingly. It is a fun, but also invaluable experience, as students learn how to work as a group and make quick decisions when the data available is constantly changing.

5. integrate learning and research strategies with lifelong learning processes and personal, academic, and professional goals.

All of the course requirements mentioned above along with duties in the National Weather Service internship (taken by the majority of atmospheric science majors) give students opportunities to learn how to do one or more of the following: (1) choose appropriate data types in analyzing significant weather or climate issues; (2) create publication-quality graphics using this data to test hypotheses and prove points; (3) search peer-reviewed literature and understand how to effectively cite journal articles in a literature review. These are necessary skills in public- and private-sector jobs in atmospheric science.
Department: Atmospheric & Environmental Sciences   Date Submitted: June 25, 2013

Major: Atmospheric Science (ATM)   Department Chair: Christopher Thorncroft

This form must be completed and submitted to the office of the Dean of your College/School by December 1, 2012. Once your Department's plan for implementing this academic competency in your major is logged by your Dean's office it will be forwarded to the UAC for review. Please complete the form using 12-point font and do not exceed 3 single-spaced pages (not including any appendices).

Competency: Critical Thinking

Critical thinking is the systematic process of analyzing and evaluating data, hypotheses, arguments, or critiques. It is an essential component of any academic major. The research, scholarship, and creative activities of university faculty ensure that our academic disciplines are constantly evolving. The facts and theories in academic disciplines are essential knowledge our students must learn, but it is mastery of critical thinking that will allow for lifelong educational and occupational development, and facilitate students’ functioning as engaged citizens. Students’ coursework in the major will cultivate in them habits of critical thinking, as they learn to approach questions and problems in critical, logical, and reflective ways.

Part 1: In the text box below, briefly describe (in about one paragraph), and in language suited to an audience composed of colleagues who are not specialists in your field, what it means to be competent in critical thinking at the undergraduate level in the discipline(s) appropriate to the major. *The text boxes in this form will expand as you type.*

Critical thinking is at the heart of atmospheric science. A major goal of atmospheric science is systematic analysis of the past and present to make reliable forecasts about the future. Students with competency in critical thinking at the undergraduate level have developed skills in recognizing what information is needed to address the problem at hand. They realize that available data has limitations and requires assessment of quality. They consider assumptions in the methods used to formulate hypotheses (forecasts) based on that data and learn the importance of comparing different methods. They appreciate the value of verifying those forecasts with what actually occurred as a means to learn and improve instead of merely as a test of being right or wrong.

Part 2: Please briefly describe how your major curriculum meets each one of the learning objectives for Critical Thinking. Please attach a description of major requirements, sample syllabi, and any other relevant materials as appendices to this document.

Students completing educational experiences that satisfy the Critical Thinking competency as part of the requirements for graduation in the major will:
1. formulate complex questions, problems, and hypotheses clearly and precisely, and apply familiar and new concepts in developing solutions and conclusions;

   The required curriculum has a quantitative base with requirements in mathematics and physics that is built upon as a student progresses through the major. Student use these skills to arrive at mathematical solutions in homework problem sets, in-class exercises, and exams in essentially all of the required core and elective courses in the major. In many cases, students must use the quantitative answer as a basis for making an explicit conclusion about some aspect of the atmosphere, weather, or climate.

   Asking well-posed questions is an integral part of science. Taking advantage of the innate propensity of young children to ask questions, it is not uncommon to perpetuate or re-instill that trait with an in-class discussion to elicit questions when presenting an observation or introducing a new topic. Several courses in the major (including required courses ATM210, ATM 425 and elective courses ATM400, ATM 401) employ the more rigorous approach of assigning a research project, with oral or written presentation, in which students must come up with a clear thesis addressing a specific scientific question or issue.

2. gather and assess relevant information/data;

   The required laboratory course PHY 145 provides an initial foundation in first-hand gathering of data through experimentation and assessing that data. The major extends this objective even further with ATM350 (Meteorological Datasets and Numerical Computation) which is devoted to accessing and assessing large data sets. Similar activities are part of ATM209, ATM211, ATM327, ATM335 (nearly all majors take one of 327 or 335 to satisfy National Weather Service requirements), and the required three-semester dynamic meteorology sequence ATM316, ATM317, ATM418. The dynamics sequence has recently been expanded from two to three semesters, dropping the former stand-alone quantitative methods course ATM315, in order to better integrate statistical data analysis into the curriculum. Much of the coursework in the updated dynamics sequence involves complex quantitative problem solving, where students must identify the data they have to work with and understand how it fits into complex equations. Gathering and evaluating information from the published scientific literature are part of research projects/writing assignments in several other courses such as ATM210, ATM400, ATM401, and ATM425.

3. test hypotheses against relevant criteria and standards, accounting for the facts;

   This is a crucial part of the scientific method. The required courses in physics and chemistry establish the principal. Students apply this principal in the discipline with quantitative exercises throughout the curriculum that challenge them to compare calculations based on physical concepts with real observations. In cases where discrepancies exist, students must assess the validity of assumptions and quality/uncertainty of data. A student gets a good dose of error analysis in ATM327. Additionally, in the synoptic meteorology course sequence, case studies are presented which require students to test hypotheses using a set of diagnostic tools, as well as evaluate
the accuracy of various types of forecasts against outcomes.

4. develop well-reasoned arguments and communicate them effectively to others;

Students make weather forecasts in ATM211 and ATM311, both oral and written. Nearly all majors continue with the elective synoptic meteorology sequence, ATM400, and ATM401 that advances these skills. This sequence is the main draw for most of the students in the major. Several required courses (see advanced writing and oral discourse) also have formal writing and/or oral presentation assignments that provide experience in meeting this objective of the competency. Exams and problem sets have questions requiring short expositions or mathematical derivations that need to be well-reasoned and effectively communicated.

5. demonstrate habits of reflection upon their own and others’ thinking—identifying, analyzing, and evaluating their own and others’ arguments; and challenging conclusions with alternative explanations or points of view.

Habits of reflection are emphasized in straightforward activities such as solving quantitative problems. Students, upon arriving at an answer, are taught to think whether the answer is reasonable, and if units are consistent with what is being asked. At the next level, weather forecasting exercises and “map discussions” (discussions of maps showing weather data) in ATM211 and later courses (e.g. ATM311, 400, and 401) entail evaluation and challenge of the interpretations of others and reconsideration of one’s own ideas. Additionally, written and oral projects are geared toward training students to critically evaluate and contrast various arguments presented in the scientific literature.