

James Russell | Teaching Statement

My teaching focuses on atmospheric dynamics with specific goals of improving student performance in marketable skills such as mathematics and programming. In all facets of teaching I refer to a set of principles that guide my course design, lesson design, and day-to-day teaching. These include being clear, concise, following goals through backward design strategies, engaging students through active learning strategies, ensuring transfer of knowledge, and learning what I can do to improve a course or lesson.

Unclear and overly verbose communication can lead to misconceptions for students. Misconceptions can be especially detrimental to students since many concepts in the atmospheric sciences rely on previously learned concepts. For example, a common misconception I find when teaching dynamics is that the thermal wind relation does not relate to a shear. When thermal wind is then implemented in the explanation of the development of jets, the misconceptions multiply. It is therefore essential to communicate clearly and concisely when teaching. To do this, I use visual aids to explain a process, keep explanations short and to the point, avoid "going off on tangents", and try to focus my courses on goals through backward design. As a part of the teaching and communication certificate, I developed a syllabus using backward design principles for Math Methods in Atmospheric Science. This course now focuses strongly on the overall goals of the topic. This allows me to be clear and concise at all times in my courses.

My classes are designed using active learning strategies. During a course I took in geoscience education, every class used the flipped class teaching structure by doing a few different activities that built on the reading assigned before class. This strategy keeps a student's attention since they aren't doing one action for hours and by disseminating the information before class, contact time with an instructor is filled with actual contact time. Since then, I have implemented the flipped class structure in my own courses with success. My dynamics and mathematical methods classes include a range of activities from running an interactive computer model, to solving a mathematical problem in groups, to discussions on the implications of an equation. These allow me to address misconceptions, interact with the students, and overall student grades in the class were improved relative to previous years when this was not implemented. Improved student performance under active learning strategies is also backed by education research.

To effectively teach, a teacher needs to know how well the students are comprehending the concepts. Further, a student should be given the option to understand where their own deficiencies exist. Formative assessment is therefore needed to assess areas where misconceptions remain. Such assessments in my courses include exercises like clicker questions during lectures that reveal broadly misunderstood concepts and discussion with individuals or groups that reveal misconceptions on the personal level. Alternatively, I build assessments into exercises such that students get feedback from their peers through peer review.

The best measure of a student's understanding is to assess whether students can transfer

knowledge; that is apply the concept they have learned in alternate situations. Exercises and assessments in my classes apply concepts in unusual or unphysical situations. This might mean applying a physical law of the atmosphere to a situation on a different planet or in a modified atmosphere. This assesses the student's understanding of concepts at higher levels of Bloom's taxonomy than just knowledge and memorization by providing them the opportunity to synthesize their knowledge, and analyze an odd situation that they may have to address in future jobs.

I am always assessing my teaching and my course materials. During and at the end of every lesson or course I will assess what went well, note exercises that could be improved, and evaluate and improve my own work. If I wasn't clear with an explanation, I will address my own understanding of the concept, examining whether I need to work on my own comprehension of the concept. If an activity did not work as planned, I will note where the activity failed and address it before I teach the lesson or course again. One way to examine what is working is through student, peer, or self evaluation. In my planning, I will do an exercise myself, attempting to put myself in the student's mind set. During class, I will regularly ask the students what they think of an exercise, lesson, or the course. This may be through formal evaluation questionnaires or, group or one-on-one discussion. Throughout my teaching career, I have continually implemented this methodology to improve my courses.

With my goals of improving student proficiency in useful skills, I developed and implemented a new core course in the NC State undergraduate curriculum called Mathematical Methods in Atmospheric Sciences. This course aims at improving the mathematical ability of atmospheric science undergraduates and introduces students to computer programming, all in the context of meteorology. I aim to continue the development and implementation of such courses that help students learn skills useful in both meteorology and the wider world.

By planning and teaching my courses through the common themes of backward design, active learning, flipped classes, and continual assessment, my courses provide students a clear route to understanding the core goals of the courses I teach.