UCO 1200: Breakthroughs and Controversies in Science and Mathematics

Professor: Dr. Sarah J Greenwald
Tues/Thur 12:30-1:45 in Walker 303a

Human beings are driven to explore ourselves and the world around us and to ask how things work. Today it may be difficult for us to imagine how mysterious the inside of a living person seemed only about 100 years ago, when x-rays were discovered in 1895. Amazing breakthroughs have been made since then, such as the invention of the atomic bomb, penicillin, cloning and artificial intelligence. In this course we will look at the process of discovery as well as the implications of recent breakthroughs and developments. Students will choose topics and explore these issues using articles, books, and television programs. We might choose to debate global warming, string theory, or Lawrence Summers' comments about the innate ability of women in mathematics, discuss the ethics of biodiesel or unbreakable codes, or explore articles about whether we still need to learn multiplication tables. In this context we will focus on what science and mathematics is, strategies for success in these fields, ethical and philosophical considerations, public perceptions, applications to daily tasks, and the relationship of science and mathematics to American competitiveness and the global economy. The only prerequisite is an open mind.

Required Resources

- iClickers (available for rental from the bookstore).
- $10 to cover the cost of class activities
- The Summer Reading book Mudbound
- On-line access to check the course web pages before each class
- Printouts of your work

Grades and Required Attendance at Events in and Outside of Class
• **Research Projects 50%** These publication-quality typed projects articulate research and analysis. Work must be turned in on or before the due date.

• **Discussion Questions 15%** Discussion questions are written responses to targeted questions on homework readings and activities that are due in advance of a class discussion. The lowest 2 discussion question grades will be dropped - save this for emergencies.

• **Reflections 15%** These typed expositions are typically 1/2-1 page long, single-spaced, that are due the day after a class discussion. The lowest reflection grade will be dropped - save this for emergencies.

• **Participation 20%** You are expected to contribute to discussions in a meaningful way and actively engage the material. You must be prepared for each class and check the main web page regularly for homework. Satisfactory completion of these kinds of baseline activities will result in a participation grade of 16/20. Utilizing office hours, the writing center and ASULearn, asking and answering thought provoking questions, coming up with creative ways of thinking about the material, and explaining the material to others are some other examples of positive participation that will increase your grade. On the other hand, actions that illustrate you are not taking the class or the activities seriously or that detract from the professional classroom environment will result in a lower participation grade. Many activities and class discussions are designed to be completed during class. Thus attendance is required at ALL classes and outside activities, and will form a portion of your grade. In addition, missing more than the equivalent of 3 weeks during the semester (6 classes) will result in an automatic F in the course (the final exam day counts as 2 classes). Save your absences for emergencies. If the university is open and you miss a class, then that counts as an absence. If you must be late to a class, or must leave early, then do still attend.

*Work may occur during the last week of classes. Accommodations in the determination of your final grade will be made for extenuating circumstances that are documented to prevent you from completing work early/on time. Except in extraordinary circumstances, requests for religious observances required by faith must be submitted in writing no later than three weeks after the first class day of the term. In addition, Appalachian State University is committed to making reasonable accommodations for individuals with documented qualifying disabilities in accordance with the Americans with Disabilities Act of 1990, and Section 504 of the Rehabilitation Act of 1973. Those seeking accommodations based on a substantially limiting disability must contact and register with The Office of Disability Services (ODS) or 828-262-3056. Once registration is complete, individuals will meet with ODS staff to discuss eligibility and appropriate accommodations. When writing up work, be sure to give acknowledgment where it is due. Submitting someone else's work as your own (PLAGIARISM) is a serious violation of the University's Academic Integrity Code. We adhere to the code in this course.

**On-Time Extra Credit** If all of your discussion questions, reflections, and research projects are turned in on time and you have received at least a grade of 70% for all work, then you will receive +1 added onto your final average.

**Turning Work in Early** If there is some reason you must miss a class, then
turn in your work early by dropping it off to my office in 326 Walker or by email to greenwaldsj@gmail.com.

**Publication Quality** You should strive to turn in work of publication quality in your research projects: neat and easy to read, complete sentences, proper grammar and spelling, correct units, well-organized, and a demonstration of your mastery of the subject matter. Future employers and teachers will expect this quality of work. Moreover, although submitting work that is publication quality requires "extra" effort, studies have shown that the effort you expend in clearly explaining your ideas solidifies your learning. In particular, research has shown that writing and speaking trigger different areas of your brain. By communicating your ideas to others - even when you think you already understand them - your learning is reinforced by involving other areas of your brain.

**Where to Get Help**

- **Office Hours** 326 Walker Hall, 262-2363. I am always happy to help you in office hours. An open sign on the door means that I am on the floor somewhere, so come look for me.
- Check the main web page often for homework and for access to the other class pages.
- ASULearn messages are the easiest way to ask a question outside of class and office hours. You are responsible for reading all posts from me. I prefer that you use office hours since it is easier to discuss material in person, but if you cannot make them, then it is a great alternative. I usually check it every day including the weekends.
- The [Learning Assistance Program](#), [Departmental Help Labs](#) and the [University Writing Center](#)

**Our First Year Seminar (FYS)**

FYS is the foundation of the university's [General Education program](#). Seminar, where the seeds of research were planted, is from the Latin root semen, which meant "seed". In the modern definition of seminar (Compact Oxford English Dictionary of Current English, 2005), it is "1. a conference or other meeting for discussion or training. 2. a small group of students at university, meeting to discuss topics with a teacher." Here is a tentative plan to satisfy the general education requirements for the class. Specific details may change over the course of the semester:

**Modes of Inquiry**
We will choose topics and explore the process of discovery using the scientific method, mathematical thinking and statistical analyses as we examine the theme of when are we convinced that a theory, experiment or proof is correct? We will also explore the controversies and implications of recent breakthroughs and developments as we connect to interdisciplinary perspectives such as ethical, philosophical, economical and psychological implications. TAKING SIDES: Clashing Views in Science, Technology, and Society is described as a book that "presents current controversial issues in a debate-style format designed to stimulate student interest and develop critical thinking skills." This text will be required and used to introduce various modes of inquiry. As a specific example of various modes, during one course, one newspaper article the students chose to discuss was titled How Baboons Think (Yes, Think). The article described a number of experiments in which researchers recorded baboon sounds and replayed them to baboons in their natural habitat. In the context of the related discussion, we highlighted:

- Sample size, randomness, and proof
- Whether the presence of humans in the area might impact the experiment and the relationship to our previous discussions on the Heisenberg uncertainty principle
- The differences and similarities of recorded sounds and natural sounds
- Whether we could measure thought in a baboon in a fair and neutral manner when it is common for us to humanize other objects and animals
- That we might like to see related results from medical imaging, and what highlighted areas on a brain scan might or might not tell us about the psychology and thought process of an animal
- Connections to religious beliefs, evolution, and Planet of the Apes
- The ethical treatment of animals and the economic implications of preserving natural habitats

**Connections to Faculty, Students, Courses, and the University**

In order to build connections to your courses, faculty, and the university, you will reflect on your own process of discovery and its implications in classes and you will also interview a professor on campus about these issues. You will be required to attend and reflect on out-of-class university sponsored experiences, with at least one of those related to the course themes. Each week we will research and advertise the mathematics and science activities at the university. Depending on student interest, the class might also visit related places on campus, such as faculty and departmental labs, the F. Kenneth and Marjorie J. McKinney Geology Teaching Museum, and the Math and Science Education Center, or we might take a field trip off campus to the Small Wind Research
and Demonstration Site or the Dark Sky Observatory and Cline Visitor Center. In order to build connections among the students, most of class time will be used to engage in group activities or class discussions and reflections.

**Freshman-Level Research Activities**

We will engage in increasingly sophisticated research activities on historical and unsolved questions in mathematics and science, and on living scientists and mathematicians. Library research and academic integrity will be addressed as a fundamental part of the course. We will conduct "low-stakes" research activities, such as:

- During one class period, teams will work together on problems similar to those used for the Consortium of Mathematics and Its Applications modeling contests, many of which would also be suitable for enhancing into research projects. You will be given a limited amount of time to work on the problems, and then you will reflect on the research process and process of discovery. Later you will follow up on a related question by conducting online research.
- You will research a professor's articles in the library databases. You will interview a professor on campus about the controversies and breakthroughs in their research.
- Teams will search for abstracts and bibliographies that are listed in the library databases and are related to topics in *Defining Moments* or *Taking Sides*.

In the first research project, you will collect data in the summer reading book using two different lenses. In the second project you will create a historical timeline and annotated bibliography that explores the interesting and important scientific and/or mathematical breakthroughs and controversies. In the third research project, you will research an unsolved scientific question or problem of interest. You will conduct a literature review and create a list of references, you will design an experiment or discuss an approach for solving the problem, and you will summarize two conflicting viewpoints related to the problem (in the style of the text *TAKING SIDES: Clashing Views in Science, Technology, and Society*). You will present your work in a poster session format. While you will not conduct any experiments, you will be encouraged to consider the possibility of doing so in the future. We will discuss the IRB process and research opportunities such as the Appalachian Undergraduate Academy of Science program and the Undergraduate Research Assistantship (URA) program.

**Ways to Meet the General Education Objectives for the First-Year Seminar**
• I. A. Recognize, differentiate, and effectively employ appropriate and increasingly sophisticated strategies to collect and interpret information;

In the "low stakes" research activities we will learn to collect and analyze information, and differentiate between scholarly and other articles. In the research projects you will apply what we have learned about research and employ a variety of strategies from various disciplines.

• I. B. Successfully integrate disparate concepts and information when interpreting, solving problems, evaluating, creating, and making decisions;

**TAKING SIDES: Clashing Views in Science, Technology, and Society** presents us with conflicting strategies to debate. During other activities we will integrate diverse strategies and analyses. For example, we will play a few rounds of the game show Friend or Foe and explore the relationship to game theory, economics, armaments races, and the ethics of what kind of research scientists should or should not support.

• I. C. Examine and evaluate how their own personal, historical, and cultural perspectives affect the discovery and generation of knowledge;

You will reflect on your own process of discovery and its implications in your classes. We will discuss how your perspectives impact your ability to respond to contradictory opinions expressed by others about controversial issues.

• II. A. Articulate and comprehend effectively, using verbal or non-verbal communication suitable to topic, purpose, and audience;

You will participate in class discussions and you will present "low stakes" research and the final project. In order to provide feedback and encourage improvement, we will utilize peer review, instructor review, and self-reflection.

• II. B. Use writing effectively to discover and develop ideas and to articulate positions in contexts of increasingly complexity;

You will write in many ways over the course of the semester and you will have the chance to improve your writing with revisions on the first two research projects. Some examples include:
• You will bring written discussion points for assigned readings.
• After a class discussion or activity, you might be asked to write down a question, to write about an aspect that surprised you, that you found interesting, or that you disagreed with, or to write about an item that relates to your own life.
• You will create reference lists, write reflection papers, and write up your research.
• IV. C. Collaborate effectively with others in a shared process of inquiry and problem-solving.

As described above, we will work in groups, we will explore problems and questions from numerous viewpoints and modes of inquiry, and you will choose many of the course topics.