INQ 250: Astronomy Controversies of the Modern Era
Fall 2015

Meeting: Trexler 273 — Time: TR 1.10–2.10p (Block 5)
Instructor: Matthew C. Fleenor — Office: Trexler 266D
email: fleenor@roanoke.edu — Office Hours: R 1–2.30p
webspace: http://www.roanoke.edu/mcsp/fleenor/ — W 2.15–4p, or by appt.

Required Readings (you need to purchase):

Miss Leavitt's Stars (MLS), George Johnson
Heart of Darkness (HoD, Ostriker & Mitton

Portions of the following (I will provide):

Skywatchers (S), Anothony Aveni
Galileo's Daughter (GD), Dava Sobel
A Brief History of Time (BHT), Stephen A. Hawking
Theoretical Concepts in Physics (TCP), Malcolm Longair

Components of Learning

There are several factors that make a course "good" (by good, I mean a healthy combination of the intellectual and the affective). Good courses are also clear about their essential components. Below is an attempt to be clear about how will I operate within INQ 250, as well as my expectations of a student who is enrolled in INQ 250.

Descriptions

Aspiration: How do the scientific processes of observation, measurement, and theorizing help to create and resolve controversy within the sciences? Is it healthy to maintain controversy regarding theories and models in the sciences; i.e., do the sciences thrive on controversy? How is controversy received and interpreted by the larger society and culture? By examining some well-known controversies within the astronomical sciences, we will explore both the quantitative arguments and the historical contexts in answering the above questions. Since physics is the proper background for astronomical studies, the course will also focus on the physical concepts and processes associated with astronomical objects. You will also take measurements, observe astronomical objects with telescopes, and interpret graphically-presented data through a required weekly night lab. The aspiration is that you will better understand the process of carrying out science and determine what makes 'good science.'

Goals & Objectives: Remember, you are primarily enrolled in the Controversies class because it satisfies the lab-science component of your liberal arts, general education program. All sections of INQ 250 share a common set of learning outcomes related to the skills students will develop in this course. These outcomes can be found at

http://roanoke.edu/Academics/Core_Curriculum/Types_of_Courses/Perspectives_Courses_in_Natural_Sciences.htm.

An outcome is a newer term in education and represents what people traditionally think of as a goal or an objective. In the 'Controversies' section of INQ 250, the common outcomes above will be developed in specific assignments tied to specific outcomes. A specific list of outcomes for this specific course is found under "Course Learner Outcomes" beginning on page 4.

Attendance: I will aspire to track daily attendance, and the following modes of learning also highlight a student's presence or absence: group work, discussion, and quizzes within the class hour. You are allowed a total of 3 absences (either un/excused) for which I do not require a note, but only an email ahead of time forewarning me of your absence (if possible). At the third un/excused absence, I will request a meeting with you and send an email to you, your Advisor, and the Registrar alerting them of the situation. After the fourth absence, you will be dropped (forcibly, with a "DF" or "DP," or willingly with a "W" before the ninth week) from the class. Besides the 'Participation' portion of the grade, one makes the best case for a "+" with a history of regular attendance and interest. Late arrivals greater than 10 minutes will constitute an official absence.

Office Hours: Besides the normal class hours, my office door is open to each student (at least) three more hours each week. If these times conflict with your schedule, please seek me out to set a time that meets your needs.

Inquire (NQR): The information found within the NQR environment is an essential component to the course itself. Notes, announcements, readings, web links, and course documents will all be placed within the course NQR. Please do NOT forget to check NQR before you come to class or if you have a question about previous assignments.

Academic Integrity (AI): All freedoms imply responsibility, and your responsibility to the RC AI policy ensures your academic freedom. I want to foster a mutual respect for the classroom hours that we have together, and AI is primarily about mutual respect (because responsibility and accountability accord). In light of this, please silence cell phones, PDAs, etc. before class and come prepared (e.g., book, paper, and pencil). Classroom computers are designed for academic learning and should be used in this manner during class; i.e., no email exchanges and/or surfing during class.

Reading, reflection, and research all involve the activity of recognizing the good thinking of others. Plagiarism exists when someone takes personal credit for another's creative (usually written) work. Hacker's A Writing Reference gives very clear examples for citing the work of others from a broad spectrum of sources (including the internet). Please use this guide when citing work during the writing that you will complete in the course. Lastly, please be advised that the RC AI policy will be upheld within this course as detailed online at –

http://roanoke.edu/A-Z Index/Registrar/Policies and Information/Academic Integrity.htm

Included here is an explanation of how violations of the College's academic integrity policy are handled.

A Word about Late Work: Please note that for all assignments a total of 50% will be deducted after one week past the due date. After two weeks past the originally-assigned due date, no credit will be awarded for the assignment.

Grades: For better and for worse, you will receive a letter grade for this course. Basic letter grades (A–F) are assigned according to the following minimum scale: "A"(92–100), "A–" (91) "B+"(88–90), "B"(83–87), "B–"(80–82), "C+"(78–79), "C"(74–77), "C–"(70-73), "D"(60–69), "F"(< 60).

Observing Lab: There is a required laboratory (WED, 5.30 – 8.30p) for the course that involves telescope observing, taking data, and drawing conclusions supported by those data. The observing lab meets at the Elizabeth Campus (EC) in Hundley Hall. Please consult the NQR site for a map to Hundley at EC. However, when the weather is poor, we may meet in TREX 273. Within the laboratory component, we will explore both astronomical observation and the physical principles supporting astronomical measurements. You must register for both the course and lab sections.

Collaboration: One stark distinctive of 21st century science is the degree of collaboration within the astronomical community. To gain some insight into this process, much time will be spent in group collaboration in/outside of class. We will spend some time discussing the difference between "collaboration" and "plagiarism." In short, collaboration relies on the individual strengths and contributions of each group member to produce a deeper level of understanding.

Modes of Learning

Rubric

Your grade is determined according to the following distribution.

Exams (4)	30%	Classwork/homework	10%	Media Journal	10%
Research Project	10%	Observing Lab	15%	Written Reflections	10%
Participation	5%	Quizzes	10%		

Descriptions

There are several researched and proven learning methodologies that we will employ to gain a better understanding of the material and its context. Below I have listed some of them and given a brief description.

Quizzes. Weekly written or online quizzes are completed individually in class and graded. Quizzes are intended to be simple and direct measures of new and cumulative knowledge that you have obtained and retained. Quizzes will only consist of a few questions, usually four or less. They could relate to the reading from the assigned selections, or these questions could be taken from the multiple choice questions at the beginning of (almost) every class. Alternatively, the quiz questions could be graphical in nature.

Media Journal. Astronomy is discussed in all sorts of venues and contexts, including newspapers, television, popular science magazines, and artistic interpretation. At certain times, you will search for a connection point with astronomy in the public media, where you will comment on the scientific accuracy of the statements made and other questions that may be pertinent. These articles and written comments (2 paragraphs or so) will be submitted electronically and graded on merits of coherence and creativity. (NOTE: Almost all internet material proceeds from source material, such as articles, books, magazines, etc. For the media journal, you must cite the source material as well as the website.)

Written Reflection. Besides the media journal reflections, there will also be several opportunities within the course to communicate about a particular article or story. You will have less control on choosing the article and/or reading because I want to ask specific questions from you. Answers to the questions will be written in paragraph form. Your final submission will include grammar, structure, coherence, and creativity as grading criteria.

Written Lab Reports. A portion of your laboratory grade is based on written reports that you will submit one week after completing a particular "experiment" (or observation). Some of these reports will be collaborative (group reports) and some will be individually written. The structure of a lab report is quite different than the above reflections, so we will discuss these differences during lab.

Exams. Exams (3) will cover the build-up of material through the class discussion, writing, quizzes, and laboratory investigation. These exams will contain questions of varying type: thought experiments, short

essay (explanative and opinionated), and graphical interpretation. All exams will contain comprehensive material from the previous chapters, probably the most missed problems from the previous exam/quizzes. Make-up exams will only be allowed as a result of a discussion with me beforehand or an emergency note (death, hospitalization, misdemeanor, etc.) signed by a governing official (medical doctor, parent, law enforcer, etc.). The final exam is scheduled for 16 DEC (WED), 2.00 – 5.00p.

Projects. There is one collaborative (research) project within the course, relating to a modern astronomy controversy of your choice. I will provide several topics, but this provision does not preclude you choosing a different topic, so long as your collaboration and I agree on the topic. You will be working in groups toward a concerted goal of presenting both sides of the argument. There is an oral and written portion to the project, and this will involve much of your own individual creative effort.

Intended Learner Outcomes

Course-wide

Successful students will:

– Identify underlying foundational tenets that shape wrong (and right) models and theories.

– Examine datasets that lead to a re-creation of the scientific arguments and a re-calculation of results supporting both sides of the controversy.

– Analyze and interpret the personal and historical stories that shape individual science paradigms.

– Synthesize data analysis and third sources to draw conclusions about a current, unresolved controversy.

Successful students will have improved their skills in:

– Identifying supporting arguments based on data versus philosophical extrapolation.

– Constructing a summative paragraph for a scientific argument.

– Constructing an informed graph and calculating the slope with its proper units.

– Manipulating simple data-taking instruments for the purpose of understanding proportions of variables.

Galileo and the Copernican Revolution

Successful students will:

– read original documents from the Galilean era that discuss science arguments and group them as supporting or opposing.

– observe differences between early models of the solar system and determine how these differences incorporate observation and/or reasoning.

– verify Kepler's third law with data from Jupiter's Galilean moons

– analyze socio-religious correspondence (e.g., Galilean era) written in response to scientific observations and identify bias and/or support.

The Great Debate of 1920

Successful students will:

– manipulate original data (Shapley GC data) to construct maps of the Milky Way that show the sun is not at the MW center.

– differentiate between measurement and inference when establishing a scientific argument, which includes identifying hidden or unstated assumptions.

Big Bang versus the Steady-State Models

Successful students will:

– extract meaningful spectroscopic results from mock observations.

– re-construct a plot of Hubble expansion (velocity vs. distance) and calculate the Hubble constant value (slope).

– read and critique personal biography (e.g., Hubble) and autobiographical correspondence (e.g., Burbidge) as it reveals underlying beliefs of particular scientists.

– utilize simple carts and timers to demonstrate that speed and acceleration are proportional.

Missing Mass, Dark Matter, and MoND

Successful students will:

– recognize the apparent imbalance between observational measurement and theoretical prediction.

– weigh the implications of creating and/or adding to established laws and models.

– measure and calculate the rotation speed of a spiral galaxy compared with an elliptical.

Final Research Project

Successful students will:

– organize pre-processed data into meaningful graphical representation as it relates to an unresolved scientific argument.

– read and summarize third source material (e.g., periodical literature NOT research journal) as it relates to current science topics.

– build a portfolio that contains both graphical representation of data as well as written argumentation in support of a side in a current controversy in astronomy.

Course Outline & Reading Guide

Please see the Outline in the following document for the exact dates of meeting for the course. The Outline also shows the daily activity and course content for our educational experience. If you have questions about scheduling, please refer to this Outline first. There is also a Reading Guide in the following documents to provide detailed information about the reading assignment for each class and the due date for assignments.