BOROUGH OF MANHATTAN COMMUNITY COLLEGE
City University of New York
Department of Science

Title of Course: Astronomy: Models
AST 106

Lecture hours: 3
Lab hours: 0
Credits: 3

Course Description: This course will focus on how astronomers have used observations to construct models of our Universe. Students will use their own observations (collected in the co-requisite AST 107 course) along with readings and class discussions, to construct and test models of our Universe.

Prerequisites: MAT 051, ENG 088, ACR 094, ESL 062
Co-requisites: AST 107

Course Student Learning Outcomes (Students will be able to…)	**Measurements (means of assessment for student learning outcomes listed in first column)**
Gather, interpret, and assess information from a variety of sources and points of view.	Students will examine observations made by classmates in AST107, as well as gather information from assigned reading and will prepare short in-class presentations on the information.
Evaluate evidence and arguments critically or analytically.	Exam questions will ask students to examine evidence for and against various astronomical models; counterfactuals will be included to ensure students are analyzing new situations rather than memorizing.
Produce well-reasoned written or oral arguments using evidence to support conclusions.	Short in-class presentations on various models will be conducted weekly on a rotating basis; homework assignments will emphasize reasoning based on observations.
Identify and apply the fundamental concepts and methods of a discipline or interdisciplinary field exploring the scientific world.	Exam and quiz questions will test knowledge and application of fundamental astronomical concepts, especially coordinate systems and hypothesis testing.
Demonstrate how tools of science, mathematics, technology, or formal analysis can be used to analyze problems and develop solutions.	In-class presentations will include analysis of competing hypotheses and discussion of critical differential tests (experimental or observational).
Articulate and evaluate the empirical evidence supporting a scientific or formal theory.	Class discussions will enumerate evidence for competing astronomical theories; students will be asked to evaluate the strength and relevance of various pieces of evidence in exam questions.

	General Education Learning Outcomes	**Measurements (means of assessment for general education goals listed in first column)**
	Communication Skills- Students will be able to write, read, listen and speak critically and effectively.	
	Quantitative Reasoning- Students will be able to use quantitative skills and the concepts and methods of mathematics to solve problems.	
☑	**Scientific Reasoning-** Students will be able to apply the concepts and methods of the natural sciences.	Pre- and Post-class tests using the peer-reviewed Classroom Test of Scientific Reasoning.
	Social and Behavioral Sciences- Students will be able to apply the concepts and methods of the social sciences.	
	Arts & Humanities- Students will be able to develop knowledge and understanding of the arts and literature through critiques of works of art, music, theatre or literature.	
	Information & Technology Literacy- Students will be able to collect, evaluate and interpret information and effectively use information technologies.	
	Values- Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.	

Required Text & Readings:
Title: Astronomy Notes
Author: Nick Strobel
Publisher: McGraw-Hill

Supplementary readings: The Copernican Revolution by Thomas Kuhn

Other Resources: 1) subway map (to develop basic orientation in the horizontal coordinate system), 2) protractor, 3) inflatable Earth globe, and 4) thumb/flash drive.

Use of Technology (if applicable): This course will make use of a variety of technologies, including Stellarium, Excel, Word, PowerPoint and email. Students will also be expected to conduct web searches for a variety of information (weather averages, for example) and may be assigned supplemental readings from internet sources. Stellarium is a free program we will use frequently – if you have home computer access, you should download it and practice with it at home: www.stellarium.org. If you do not have home computer access, the Science computers in the Learning Resource Center (S-510) have Stellarium installed, and you should use their open hours to familiarize yourself with it.

Evaluation & Requirements of Students

HW/classwork/presentations	20%
Quizzes, attn/participation	14%
Midterm exams	36%
Final Exam	30%
Total	100%

Outline of Topics

Week 1	Introduce concepts of angular measurement. Establish the horizontal coordinate system (HCS) in NYC; define terms: observation, measurement.
Week 2	Examine comprehensive observations of Sun in HCS (covering one year); identify patterns in observations (including: variation in max altitude, consistency of azimuth at max altitude, variation of azimuth at sunrise and sunset, variation in time of max altitude, variation in time of sunrise and sunset).
Week 3	Examine relationship between astronomical events and cultural constructs including the civil calendar, clock time, time zones and daylight savings time; Use models and observations to analyze relationship between clock time and solar time; Justify time zones, daylight savings time
Week 4	Relate HCS to global coordinate system (GCS – latitude and longitude); use observations to construct model for Sun's daily motions; use observations to construct model of Sun's annual motions
Week 5	Use model of Sun's daily and annual motions, plus HCS and GCS, to predict observations for diverse locations on Earth, examine consequences of these predictions (e.g. climate) and compare predictions to worldwide observations (using e.g. weather averages)
Week 6	Use observations of stars in HCS to construct concept of celestial sphere.
Week 7	Use observations of stars in HCS to construct equatorial coordinate system (ECS) model of celestial sphere; Use observations to examine differences between solar time and sidereal time and suggest models to account for difference.
Week 8	Use ECS observations of annual motions of Sun with respect to stars to construct holistic geocentric model (Sun and stars together)
Week 9	Historical/cultural significance of stars/constellations/relationship with sun (mostly western but include brief looks at other world cultures)
Week 10	Use all collected observations to date (Sun and stars) to construct self-consistent heliocentric model
Week 11	Using observations of Mars in ECS, construct model for motion of Mars in geocentric and heliocentric models
Week 12	Discuss historical impact of pre-Copernican physics and theology, 'revolutionary' nature of heliocentric model, historical progression of the Copernican Revolution up to Kepler and Galileo
Week 13	Isaac Newton and the laws of motion; universal gravitation; comparison of the case for the heliocentric and geocentric models
Week 14	Stellar parallax: model predictions and analysis of observations
Week 15	Final Examination

College Attendance Policy
At BMCC, the maximum number of absences is limited to one more hour than the number of hours a class meets in one week. For example, you may be enrolled in a three-hour class. In that class, you would be allowed 4 hours of absence (not 4 days). In the case of excessive absences, the instructor has the option to lower the grade or assign an F or WU grade.

Academic Adjustments for Students with Disabilities
Students with disabilities who require reasonable accommodations or academic adjustments for this course must contact the Office of Services for Students with Disabilities. BMCC is committed to providing equal access to all programs and curricula to all students.

BMCC Policy on Plagiarism and Academic Integrity Statement
Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism.

Students who are unsure how and when to provide documentation are advised to consult with their instructors. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's web side, www.bmcc.cuny.edu. For further information on integrity and behavior, please consult the college bulletin (also available online).