

SYLLABUS - Astronomy

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OVERVIEW

This course is designed to open a window for you to the Universe, to provoke your imagination, and to address some fundamental and tantalizing questions. What makes the Sun and the stars shine? Why do some stars explode as supernovae? Do black holes really exist? Is there a giant black hole at the center of our Galaxy? How did galaxies form? Is there 'dark matter' in galaxies? Why is the sky dark at night? When did the Universe begin? Is there an 'edge' to the Universe? How was our Solar System formed? Are there other solar systems? Could there be life elsewhere in the Universe and could we find it? These are a few examples of questions that will be discussed. Astronomers do not have definitive answers to all these questions, but they have made remarkable progress towards answering many of them.

The observable Universe is a time machine - the only one we have. When we look outward in space we also look back in time. In this course we will travel from the Solar System to the edge of the observable Universe. In so doing, we will venture back to the beginning of time. We will calibrate our place in the Universe.

SPECIFICS

OUTLINE: The course is divided into four parts: (1) Introduction to Astronomy, (2) The Solar System (3) Stars and Galaxies, (4) Cosmology and Life in the Universe.

METHOD: Material will be covered by your research on the world wide web, presentations by students, discussions of the web assignments, and laboratory type activities. You are responsible for the material presented during any aspect of the course. Exams will be based mostly on specific questions which will be asked during class and reviews.

HINTS FOR SUCCESS: You are encouraged to ask questions during class. This is your opportunity, so take it! Also, if we are going too fast or something is not clear please tell me, and we will certainly try to slow down or repeat. In addition to your own research and reading there will be many classroom presentations. Keep a journal where you record what took place that day and detailed notes of the material discussed.

Activities which are to be done for the course such as making observations should be completed as early as possible. Weather may not cooperate if you wait until the last opportunity.

WORLD WIDE WEB PAGE: A World Wide Web page has been created for this class, and its address is the following: <http://www.bartol.com/astro.htm>

EXAMS AND GRADING: Three (3) quizzes and one (1) final exam will be given. All will consist of multiple-choice and short answer questions.

The dates for the quizzes will be announced. Your lowest quiz will be dropped, and the remaining two (2) will each constitute 20 percent of your grade. Since one quiz will be dropped, no makeup quizzes are anticipated. In special cases such as more than one excused absence from quizzes you must contact me as soon as possible regarding a makeup quiz, and the format of the "make-up" quiz will be at my discretion.

A term research project will constitute 25 percent of the grade. You are expected to participate in evening observation sessions with the class and a planned field trip. This participation and observation activity reports will constitute 15 percent of the grade. The final exam will be a quiz made up of questions from previous quizzes and will constitute the final 20 percent of the grade.

Calculators cannot be used for the quizzes or the final exam. I have carefully designed the questions so that calculators are not necessary.

This course is supposed to teach you about the main important aspects of astronomy rather than lots of small details. The quizzes and final will be designed to probe your understanding of the main important aspects. I try to avoid asking 'trick questions' and questions about small details. The important concepts will be clearly emphasized in class.

AVAILABILITY AND QUESTIONS: You are encouraged to visit Room 212 between 7:00 a.m. and morning meeting (days 1, 2, 4 and 5) for help with the course material or to ask any questions you may have about astronomy. I am also available by appointment during most lunch periods and after school on days 2 and 5. Feel free to send e-mail to docb@bartol.com if you prefer to ask questions that way.

OPTIONAL READING: There are many excellent books that explain various astronomy topics at an introductory level. One book that may be of particular interest is *The Stars: A New Way to See Them* by H.A. Rey. This book clearly explains the constellations, the motions of celestial objects, and other 'practical astronomy' topics. If you have a burning desire to learn the constellations, then this is a great book for you.

There are many other good introductory astronomy books on topics such as the Hubble Space Telescope, star formation, supernovae, black holes, the Galaxy, and cosmology. I will not list books here, but if you are interested in a particular topic please feel free to contact me and I'll do my best to suggest an appropriate book.

For absolute clarity, let me state that optional reading is not required to do well in this class, and you should not feel compelled to buy optional books. Optional reading is only mentioned to help those who have special interest in a particular area and want to go beyond what is covered in class.

OBSERVING EVENTS: It will be necessary for you to participate in scheduled observations of the sky. Dates you should reserve are: January 9 and 20, February 2 and 15, and March 6 evenings. Morning observations will be on January 27 and February 23. Evenings are about 5:30 p.m. (8:00 p.m. in March) and morning observations are about 5:30 a.m. Specific times will be announced later. Plan to spend about an hour at the school beginning at the announced starting time. Please dress warm with heads and hands covered. We will meet at the field near the arts wing, and we will be moving from there. In event of cloudy skies the session will be cancelled. I will leave a message on the school phone at extension 229 if there is a cancellation. A field trip to the Hayden Planetarium is scheduled for January 31 leaving at 2:35 p.m. and returning about 9:00 p.m. The alternate date is February 28 in event of weather cancellation.

EXPENSES: The cost of the trip to the Rose Center in New York will be the only expense for the course. Admission is \$10.00; dinner is your own choice; and the transportation cost will be paid by Newark Academy.

SPECIFIC OBJECTIVES:

At the completion of the course a student should be able to demonstrate knowledge of the following:

- I. Observational Astronomy
 - A. Constellations
 - B. Zodiac and its use in observations
 - C. Bright star names, colors, and magnitudes
 - D. Visible planets and their motions
 - E. Motions of the Sun and Moon including surface features and phases.
 - F. Galaxies and nebula including Messier numbers

- II. Introduction, gravitation, motions in solar system
 - A. Contributions of various astronomers throughout the ages (Ptolemy, Copernicus, Galileo, Kepler, Newton, Herschel, Hubble, and others).
 - B. Geocentric versus heliocentric theories
 - C. Planetary motions and Kepler's and Newton's laws.
 - D. Time and calendars.
 - E. Distance, vastness, parallax
 - F. Use of celestial coordinates to locate objects on the celestial sphere.
 - G. Cause of seasons
 - H. Precession and changes in the sky throughout time
 - I. Cause and nature of tides
 - U. Eclipses

- III. Light and Optics
 - A. Electromagnetic spectrum.
 - B. Optics including light gathering and reflection, refraction, and dispersion of light.
 - C. Relation between brightness and distance.
 - D. Construction and characteristics of different types of telescopes
 - E. Radio telescopes and their contributions to astronomy—IR, UV, x-ray, and gamma astronomy.
 - F. Magnification and resolution of optical devices.

IV. Planets

- A. Overview of the solar system.
- B. Planets in our solar system
- C. Planetary data and its interpretation.
- D. Bode's Law
- E. Satellites of the planets.
- F. Extra-solar planets and their discovery.
- G. Properties of asteroids, meteors, and comets.
- H. Evolution of the solar system.

V. Light and matter

- A. Black body radiation.
- B. Spectra of various stars.
- C. Doppler effect

VI. Stellar structure and evolution.

- A. Structure and characteristics of a typical low-mass star...the Sun
- B. Source of stellar energy (nuclear fusion).
- C. Data from stars and conclusions.
- D. Apparent versus absolute stellar magnitudes.
- E. Stellar mass, luminosity, size, temperature, color, class, and distance
- F. Characteristics of different types of star clusters.
- G. Variable stars including Cepheid variables and their usefulness.
- H. Interstellar medium
- I. Significance of the HR diagram.
- J. Red giants, white and black dwarfs, novae, pulsars, and neutron stars...black holes.

VII. Galaxies and cosmology.

- A. Classification of galaxies.
- B. Magnitudes, dimensions, masses, and distances to galaxies.
- C. Hubble Law
- D. Cosmology and the big bang theory.

VIII. Space flight.

- A. History and future of manned and un-manned vehicles.
- B. Observatories.
- C. Current events in astronomy.
- D. Benefits and advances of exploration.