

ASTR 10BH: HONORS GENERAL ASTRONOMY: STARS, GALAXIES, COSMOLOGY

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Fall 2020
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Advisory:	Concurrent enrollment in ASTR 10L; not open to students with credit in ASTR 10B.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area III: Natural Sciences
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Understand the position of the Earth in the universe and the arrangement and scale of the universe.
- Understand the life story of the stars and be able to explain how that life story relates to their own lives and existence here on Earth.

Description

Non-technical introduction to astronomy, focusing on qualitative reasoning about stars, galaxies, and the origin and evolution of the universe. Topics include: the nature of light, matter, and telescopes; the basic physical processes of the universe; the formation and death of stars and their role in producing the elements necessary for life (including an introduction to black holes); the Milky Way and other galaxies, their structure, formation, and evolution; the history, evolution, and structure of the universe from the Big Bang to the heat death of the universe; the impact of astronomical events on life on Earth. The honors section offers a challenging intellectual environment which covers the same outline as the general course but in more depth.

Course Objectives

The student will be able to:

- Use light and spectra to compare the temperature, composition, speed, and distance of objects
- Draw scale models of astronomical objects and timelines of astronomical events
- Qualitatively reason about physical situations, and use plots of physical relationships to quantify reasoning
- Present a "big picture" view of the cosmos from the Earth to the edge of the observable universe
- Describe the evolution of stars from birth to death and discuss how this evolution relates to their own lives on Earth

- Use observations of stars to construct our modern understanding of the structure, history, and evolution of galaxies
- Use observations of galaxies to construct our modern understanding of the structure, history, and evolution of the overall universe
- Communicate about phenomena in an audience appropriate manner

Course Content

- Light
 - The electromagnetic spectrum
 - Interactions of light with matter
 - Spectroscopy
 - Measuring temperatures with light
 - Measuring compositions with light
 - Measuring radial velocities with light
 - Luminosity
 - Using temperature and luminosity to determine the size of stars
 - Using distances and apparent brightness to determine luminosity
- Scale models and timelines
 - Using division to make scale models of size and distance
 - Relating astronomical scales to day-to-day situations
 - Factor of 10 comparisons
 - Make astronomical timescales relatable via scaling to a calendar year
- Qualitatively reason about physical situations, and use plots of physical relationships to quantify reasoning
 - Use distance and mass to compare the gravitational force between objects, and use these comparisons to predict resulting motions
 - Predict high or low orbital speed based on mass and separation, and read plots of speed vs. separation to determine masses of binary stars
 - Use combinations of distance and apparent brightness to compare the luminosity of sources, and combinations of luminosity and apparent brightness to compare the distance of sources
 - Use parallax to compare the distances of objects
 - Predict high or low temperatures based on the amount of compression of gasses, and the relationship between mass and the amount of compression
 - Predict high or low fusion rates based on the temperature and density of gasses, and interpret stellar luminosities in terms of fusion rate
 - Compare stellar lifetimes based on comparisons of mass and luminosity, and use stellar census to estimate ages of stellar populations
 - Use Doppler shift to compare line-of-sight velocities, and use patterns in Doppler shifts to describe large scale motions and phenomena
- Present a "big picture" view of the cosmos from the Earth to the edge of the observable universe
 - Describe the basic properties of stars and groups of stars
 - Describe the basic properties of galaxies
 - Describe the overall structure and history of the universe
 - Use the scale of space, history of the galaxy, and history of life on Earth to reason about life in the universe
- Describe the evolution of stars from birth to death and discuss how this evolution relates to their own lives on Earth
 - Use concepts of gravity, the compression of gasses, and fusion to predict which types of stars will produce different elements via fusion
 - Use properties of stars on the H-R diagram to infer mass, fusion rate, and lifetime
 - Processes that follow the exhaustion of core hydrogen in stars and how these vary with stellar mass
 - Shells of formation of heavy elements
 - Evolution to red giants and formation of planetary nebula
 - Core collapse and supernovas of high mass stars
 - Explore the objects leftover after stellar "death"

- a. White dwarfs, and supernovas resulting from interaction with a binary companion
- b. Neutron stars, and kilonovas resulting from neutron star mergers
- c. Black holes, and an introduction to relativity
- F. Use observations of stars to construct our modern understanding of the structure, history, and evolution of galaxies
 - 1. Use observations of stars, gas, and variable stars to measure the size and shape of the Milky Way
 - 2. Use observations of variable stars and Type Ia supernovas to measure the distance to galaxies
 - 3. Use velocity measurements of stars to recreate the discovery of dark matter
- G. Use observations of galaxies to construct our modern understanding of the structure, history, and evolution of the overall universe
 - 1. Use observations of galaxies at a variety of distances to confirm models of galaxy formation and interaction
 - 2. Use galactic redshifts and distances to recreate the discovery of the Hubble law, and interpret the changing slope of the Hubble in terms of the accelerating expansion of the universe
 - 3. Extrapolate the overall conditions of the universe to the time of its formation, and interpret the discovery of the cosmic microwave background in that context
- H. Communicate phenomena in an audience appropriate manner
 - 1. Outline the key facts and processes of a phenomenon
 - 2. Use audience appropriate communications strategies to make processes relatable

Lab Content

Not applicable.

Special Facilities and/or Equipment

- A. Physics equipment for demonstrating the generation of atomic spectra and other relevant physics principles.
- B. A large classroom with good audio-visual equipment, including facilities for showing PowerPoint slides and web-based images.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

- A. Quizzes
- B. Midterm exam(s)
- C. Final exam
- D. Collaborative group activities (with written submissions)
- E. Homework assignments (with additional in-depth questions appropriate for honors students)
- F. Participating in the class discussion by asking and answering questions both in-person and in online discussions
- G. A term paper or similar culminating project aimed at communicating an astronomical process to others

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

- A. Preparatory reading
- B. Lecture with integrated practice
- C. Group activities during the lecture
- D. Student discussion
- E. Peer review

Representative Text(s) and Other Materials

Fraknoi, A., D. Morrison, and S. Wolff. [OpenStax Astronomy](#). OpenStax at Rice University, 2016.

Additional handouts from the instructor.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

- A. Weekly required reading from the textbook, 30-50 pages per week. Includes special sections required of honors students only.
- B. Reading of update sheets and handouts, number of pages varies.
- C. Written homework questions to be handed in some weeks.
- D. Student groups meet outside of class for regular review.
- E. Write an essay, blog-style post, cartoon, video, poster, spoken presentation, etc., to communicate about an astronomical phenomenon in a target appropriate manner.

Discipline(s)

Astronomy/Physics