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

## Foothill College Course Outline of Record

| Heading | Value |
|---|---|
| **Effective Term:** | Summer 2025 |
| **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 5: Natural Sciences w/ Lab |
| **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 with additional training in information literacy and communications.

## Course Objectives

The student will be able to:

1. Use light and spectra to compare the temperature, composition, speed, and distance of objects
2. Draw scale models of astronomical objects and timelines of astronomical events
3. Qualitatively reason about physical situations, and use plots of physical relationships to quantify reasoning
4. Present a "big picture" view of the cosmos from the Earth to the edge of the observable universe
5. Describe the evolution of stars from birth to death and discuss how this evolution relates to their own lives on Earth
6. Use observations of stars to construct our modern understanding of the structure, history, and evolution of galaxies
7. Use observations of galaxies to construct our modern understanding of the structure, history, and evolution of the overall universe
8. Communicate about phenomena in an audience appropriate manner

## Course Content

1. Light
   a. The electromagnetic spectrum
   b. Interactions of light with matter
   c. Spectroscopy
      i. Measuring temperatures with light
      ii. Measuring compositions with light
      iii. Measuring radial velocities with light
   d. Luminosity
      i. Using temperature and luminosity to determine the size of stars
      ii. Using distances and apparent brightness to determine luminosity
2. Scale models and timelines
   a. Using division to make scale models of size and distance
   b. Relating astronomical scales to day-to-day situations
   c. Factor of 10 comparisons
   d. Make astronomical timescales relatable via scaling to a calendar year
3. Qualitatively reason about physical situations, and use plots of physical relationships to quantify reasoning
   a. Use distance and mass to compare the gravitational force between objects, and use these comparisons to predict resulting motions
   b. Predict high or low orbital speed based on mass and separation, and read plots of speed vs. separation to determine masses of binary stars
   c. 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
   d. Use parallax to compare the distances of objects
   e. Predict high or low temperatures based on the amount of compression of gasses, and the relationship between mass and the amount of compression
   f. Predict high or low fusion rates based on the temperature and density of gasses, and interpret stellar luminosities in terms of fusion rate
   g. Compare stellar lifetimes based on comparisons of mass and luminosity, and use stellar census to estimate ages of stellar populations
   h. Use Doppler shift to compare line-of-sight velocities, and use patterns in Doppler shifts to describe large scale motions and phenomena
4. Present a "big picture" view of the cosmos from the Earth to the edge of the observable universe
   a. Describe the basic properties of stars and groups of stars
   b. Describe the basic properties of galaxies

   c. Describe the overall structure and history of the universe
   d. Use the scale of space, history of the galaxy, and history of life on Earth to reason about life in the universe
5. Describe the evolution of stars from birth to death and discuss how this evolution relates to their own lives on Earth
   a. Use concepts of gravity, the compression of gasses, and fusion to predict which types of stars will produce different elements via fusion
   b. Use properties of stars on the H-R diagram to infer mass, fusion rate, and lifetime
   c. Processes that follow the exhaustion of core hydrogen in stars and how these vary with stellar mass
      i. Shells of formation of heavy elements
      ii. Evolution to red giants and formation of planetary nebula
      iii. Core collapse and supernovas of high mass stars
   d. Explore the objects leftover after stellar "death"
      i. White dwarfs, and supernovas resulting from interaction with a binary companion
      ii. Neutron stars, and kilonovas resulting from neutron star mergers
      iii. Black holes, and an introduction to relativity
6. Use observations of stars to construct our modern understanding of the structure, history, and evolution of galaxies
   a. Use observations of stars, gas, and variable stars to measure the size and shape of the Milky Way
   b. Use observations of variable stars and Type Ia supernovas to measure the distance to galaxies
   c. Use velocity measurements of stars to recreate the discovery of dark matter
7. Use observations of galaxies to construct our modern understanding of the structure, history, and evolution of the overall universe
   a. Use observations of galaxies at a variety of distances to confirm models of galaxy formation and interaction
   b. 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
   c. 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
8. Communicate phenomena in an audience appropriate manner
   a. Outline the key facts and processes of a phenomenon
   b. Use audience appropriate communications strategies to make processes relatable

## Lab Content

Not applicable.

## Special Facilities and/or Equipment

1. Physics equipment for demonstrations.
2. Internet access for in-class use of web-based tools.
3. Audio-visual equipment.

## Method(s) of Evaluation

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

Collaborative group activities
Repeated use of formative assessment throughout each class meeting
Homework incorporating feedback and correction opportunities
Online written discussions
Quizzes
Exams (midterm and final)
A term paper may or may not be required

## Method(s) of Instruction

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

Cooperative learning exercises
Lecture with continuous use of formative assessment
Discussion
Multiple practice opportunities outside of class
Demonstrations
Preparatory reading before class meetings
Mixed media instruction (video, readings, and simulations intertwined, with embedded practice questions and formative assessment)

## Representative Text(s) and Other Materials

Fraknoi, Andrew, David Morrison, and Sidney Wolff. Astronomy 2nd ed. (OpenStax). 2022.

Prather, Ed, Gina Brissenden, Colin S. Wallace, and Jeffery P. Adams. Lecture Tutorials for Introductory Astronomy, 4th ed.. 2021.

Additional handouts from the instructor.

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

1. Weekly required reading from the textbook, 30-50 pages per week. Includes special sections required of honors students only.
2. Reading of update sheets and handouts, number of pages varies.
3. Iteratively write a blog--style post (or other appropriate communication style) to communicate about an astronomical phenomenon in a manner appropriate for the general public.

## Discipline(s)

Astronomy/Physics