

**Outcome 1: Students will acquire a body of astronomical knowledge.** Students should be able to do some of the following:

- a. Discuss and give examples of several broad areas of current astronomical research.
- b. Discuss and summarize selected topics in depth (topics may include: orbital dynamics and gravity, star formation and stellar evolution, observational methods, extragalactic astrophysics, cosmology, stellar populations and Galactic astronomy, solar system and planetary astronomy, extrasolar planets, high energy and particle astrophysics).
- c. Describe and critique a wide array of current research topics.
- d. Demonstrate fundamental knowledge of the cognate areas of Physics and Mathematics (including electricity and magnetism, optics and wave phenomena, thermodynamics and statistical physics, quantum mechanics, classical mechanics, special relativity, vector calculus, differential equations, linear algebra, and statistics).

**Outcome 2: Students will develop fundamental skills for astronomical problem solving.** Students should be able to do some of the following:

- a. Identify the problem to be investigated and the appropriate methods for approaching the problem, including both numerical and observational techniques.
- b. Apply commonly-used observational and numerical techniques with appropriate precision.
- c. Identify and implement appropriate data analysis procedures including inspection of data quality, data processing, and data analysis.
- d. Communicate results effectively, including appropriate graphical analysis and written and oral descriptions of research topic and methodology.
- e. Critically assess limitations, assumptions, and significance of results obtained.

**Outcome 3: Students will be aware of and show mastery of various modes of scientific thinking employed by astronomers in conducting astronomical research.** Students should be able to do some of the following:

- a. Demonstrate quantitative problem solving skills in an astronomical context.
- b. Demonstrate qualitative problem solving skills by, for example, explaining astronomical phenomena based on a conceptual understanding, generating reasonable assumptions within an astronomical context, and applying quick and effective estimation.
- c. Demonstrate organized, logical thinking.
- d. Demonstrate appropriate scientific judgment, including drawing correct conclusions from numerical solutions.
- e. Explain and apply the scientific method to astronomical research problems.
- f. Explain the importance of independent verification of discoveries in astronomy.
- g. Describe the scale of astronomical research programs (from small projects to large surveys) and explain the importance of data archives, including the value of both anticipated and serendipitous discoveries.

**Outcome 4: Students will develop effective communication skills appropriate for astronomers.**

Students should be able to do some of the following:

- a. Use both oral and written expression to discuss or explain astronomical phenomena in a variety of formats (including long and short papers, formal presentations, and informal group and collaborative discussions).
- b. Demonstrate a familiarity with standards for scientific writing, including proper citation and attribution, and appropriate professional presentation styles.
- c. Recognize the needs of, and communicate with, diverse audiences.
- d. Explain clearly physical and astronomical principles and the context for astronomical results and discoveries.

**Outcome 5: Students will be aware of and be able to demonstrate the skills needed for success in the workplace, whether in graduate school or on another career path.** Students should be able to do some of the following:

- a. Describe steps toward a variety of career options such as graduate school, technical careers within and outside astronomy, and non-technical careers such as teaching, public outreach, science journalism, science policy, etc.
- b. Work independently and in teams, including sharing responsibility to complete complex tasks.
- c. Demonstrate an awareness of and an ability to adopt appropriate behavior in professional situations.
- d. Articulate responses to ethical situations that are consistent with disciplinary norms.
- e. Reflect on his/her participation within the scientific community and within the global, multicultural workplace.