San Diego State University

Master of Science Degree, Department of Astronomy

Program Mission

The Master of Science (MS) degree in Astronomy is designed to prepare students either for further graduate work leading to the doctorate, or for a professional career in teaching or in industry. All students will complete coursework in astronomy and closely related fields, and then complete either a written thesis ("Plan A") or pass a comprehensive examination ("Plan B").

What follows are the Program Learning Goals (PLGs), Degree Learning Outcomes (DLOs), and Curricular MAP that lead to the *Master of Science* degree in Astronomy. The PLGs and DLOs for Plan A and Plan B are identical except that Plan B does not include PLG-5.

Program Learning Goals (PLGs)

- PLG-1: Apply physical principles

  Apply physics to the investigation of scientific questions in cosmology; galaxies; galactic structure and evolution; stellar atmospheres and interiors; and astronomical observing and data analysis techniques.

- PLG-2: Investigate astronomical theories

  Develop a conceptual understanding of the major theories describing the formation, evolution, and fate of astronomical entities (stars, galaxies, and the universe), and investigate the observational evidence related to these theories.

- PLG-3: Critically evaluate scientific information

  Critically evaluate and interpret quantitative astronomical information (including observational data and computer models) within the framework of the scientific method.

- PLG-4: Communicate scientific information

  Effectively communicate scientific ideas in oral and written forms.

- PLG-5: Develop research skills

  Develop the technical, computational, and analytical skills needed to pursue an individualized research project and/or be able to critically read and evaluate the merits of published research.

Degree Learning Outcomes (DLOs)

- DLO-1: Apply scale arguments

  Apply the concepts of time, length, mass, and energy scales to understand the most important physical processes at work in different parts of the Universe.

- DLO-2: Critique the distance scale

  Identify the techniques that are used to measure the distances to different astronomical objects, explain the conceptual basis for each measurement method (such as trigonometry, standard candles, standard rulers, standard sirens, and the Hubble Law), and evaluate how they are assembled to produce a distance scale covering all astronomical objects.

- DLO-3: Describe the interactions of electromagnetic radiation

  Identify the origins of various forms of electromagnetic radiation, and describe the physical principles behind the interactions between radiation and matter (including astronomical detectors).

- DLO-4: Demonstrate a working knowledge of gravitation

  Apply quantitative Newtonian gravitational principles to the study of stars, galaxies, and cosmology. Demonstrate a qualitative understanding of the implications that general relativistic principles have when interpreting the foundational equations of cosmology.

- DLO-5: Evaluate star and planet formation theory

  Enumerate the steps of the theory that stars and planets form from large interstellar gas clouds, explain the physics justifying each step, and evaluate the theory by examining evidence collected from the solar system, other star systems, and gas clouds.

- DLO-6: Evaluate stellar evolution theory

  Examine the construction of theoretical models of stars from physical principles, and compare models to the observed characteristics of stars.

- DLO-7: Evaluate galaxy formation theory

  Enumerate the steps of the theory that galaxies form from overdensities in the early universe, explain the physics justifying each step, and evaluate the theory by examining evidence collected from local and high-redshift galaxies and the intergalactic medium.

- DLO-8: Evaluate Big Bang theory

  Identify the evidence that led to a picture of an expanding universe, utilize physical principles to assemble a history of the evolution of the early universe, and explain how these lead to testable predictions about the universe's history and future. Construct an argument based on astronomical evidence that the universe has evolved from a hot, dense state. Present the currently favored scientific theory for what the ultimate fate of our universe will be, and outline the astronomical observations upon which it is based.

- DLO-9: Explain research motivation

  Explain the motivation and goals for a research project in clear language.

- DLO-10: Use astronomical tools

  Use astronomical instruments (such as telescopes and detectors) to collect observational data, or demonstrate the analytical skills required to undertake a theoretical model, or both.

- DLO-11: Analyze observational data

  Calibrate, analyze, and model observational data in order to test appropriate theories, or undertake theoretical calculations to describe existing data.

- DLO-12: Assess uncertainties in data

  Assess the uncertainties in observational data or numerical simulations to evaluate the potential to successfully address a scientific question.

- DLO-13: Draw sound conclusions from evidence

  Draw sound conclusions from observational or theoretical evidence.

- DLO-14: Present current astronomical research advances

  Be able to create and give an oral presentation that clearly demonstrates advanced understanding of a current research topic in astronomy.

Curricular Map: Master of Science Degree in Astronomy

The following Table lists the courses currently offered by the Department of Astronomy that are applicable to the Master of Science Degree in Astronomy (see the current SDSU Graduate Bulletin for specific requirements), along with the Degree Learning Outcomes (DLOs) that are (I)ntroduced, (P)racticed, and/or (D)emonstrated in each course.

Table 1. Curricular MAP for the Master of Science Degree in Astronomy

Course	DLO-1	DLO-2	DLO-3	DLO-4	DLO-5	DLO-6	DLO-7	DLO-8	DLO-9	DLO-10	DLO-11	DLO-12	DLO-13	DLO-14
ASTR 510: Exoplanets					IPD				I	IPD	IPD	PD		PD
ASTR 610: Bin. Stars	PD		PD	PD			PD		P				PD	
ASTR 630: Stars	IPD	P	PD	P	IP	IPD			PD	P	P		P	PD
ASTR 650: Galaxies	IPD		IPD	IPD			IPD		IPD		PD	P	P	IPD
ASTR 670: Cosmology	IP	IPD	P	IPD			I	IPD	PD		P	I	P	IPD
ASTR 680: Astr. Tech.	P	PD	I D					D	IPD	IPD	IPD	IPD	PD	PD
ASTR 799: Thesis									D	D	D	D	D	D

Note. — I=Introduced; P=Practiced; D=Demonstrated