### I. ASCRC General Education Form

<table>
<thead>
<tr>
<th>Group</th>
<th>XI Natural Sciences</th>
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<tbody>
<tr>
<td>Dept/Program</td>
<td>Physics and Astronomy</td>
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<tr>
<td>Course #</td>
<td>ASTR U 134N</td>
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<tr>
<td>Course Title</td>
<td>Elementary Astronomy Laboratory I</td>
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<tr>
<td>Prerequisite</td>
<td>ASTR 131N is a pre- or co-requisite</td>
</tr>
<tr>
<td>Credits</td>
<td>1</td>
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### II. Endorsement/Approvals

Complete the form and obtain signatures before submitting to Faculty Senate Office

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Diane Friend</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone / Email</td>
<td>4299</td>
<td><a href="mailto:diane.friend@umontana.edu">diane.friend@umontana.edu</a></td>
<td>9/18/08</td>
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<tr>
<td>Program Chair</td>
<td>Andrew Ware</td>
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<tr>
<td>Dean</td>
<td>Gerald Fetz</td>
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### III. Description and purpose of the course:

General Education courses must be introductory and foundational. They must emphasize breadth, context, and connectedness; and relate course content to students’ future lives: See Preamble: [http://www.umt.edu/facultysenate/gened/GEPreamble_final.htm](http://www.umt.edu/facultysenate/gened/GEPreamble_final.htm)

This course provides practical, laboratory experiences in observational and solar system astronomy as a supplement to Introductory Elementary Astronomy I (ASTR 131N). Students learn how astronomers make observations and models that lead to a greater understanding of how the universe works through exposure to the tools and techniques that astronomers use, an understanding of the physical principles involved, and an exposure to data acquisition, analysis, critical thinking, and the scientific method.

### IV. Criteria:

Briefly explain how this course meets the criteria for the group. See: [http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm](http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm)

1. **Courses explore a discipline in the natural sciences and demonstrate how the scientific method is used within the discipline to draw scientific conclusions.**

   The primary purpose of this course is to teach students about the process of science. The emphasis is on experimentation, observation, and critical thinking as applied to the discipline of astronomy.

2. **Courses address the concept of analytic uncertainty and the rigorous process required to take an idea to a hypothesis and then to a validated scientific theory.**

   Laboratory activities progress from modeling activities which familiarize students with a broad range of astronomical phenomena to specific experiments and observations which require students to become familiar with the scientific process and focus on a particular physical law or the characteristics of a specific solar system body. The course is designed to expose students to a wide range of investigative and data analysis techniques.
3. Lab courses engage students in inquiry-based learning activities where they formulate a hypothesis, design an experiment to test the hypothesis, and collect, interpret, and present the data to support their conclusions.

Students become competent in the use of telescopes, a variety of sky simulation software programs, star maps and globes, specialized maps (geological, topographical, etc.) of solar system bodies, and how to use web resources to find astronomical data. Activities include modeling orbital motions, using Kepler’s Laws and observations of Jupiter’s moons to determine the mass of Jupiter, modeling lunar and solar eclipses, experiments in optics, photo and map explorations of the surface of planetary bodies, and collecting and examining micrometeorites. Laboratory activities closely follow, and elaborate on, the discussion of similar topics in the lecture course, ASTR 131N.

V. Student Learning Goals: Briefly explain how this course will meet the applicable learning goals. See: [http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm](http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm)

1. Students will understand the general principles associated with the discipline(s) studied.

   The great synthesizing principles relevant to the solar system are emphasized: Kepler’s laws of planetary motion, Newton’s law of gravity, the solar nebular theory, and comparative planetology.

2. Students will understand the methodology and activities scientists use to gather, validate and interpret data related to natural processes.

   Students engage in experimental, observational, and computer modeling activities that mirror the actual methods astronomers use to determine many of the physical and solar system properties that are explored in ASTR 131N. See below for some specific activities.
3. Students will detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments.

Lab activities are designed to address these goals. Some specific examples:

A lab on Eclipses and Orbits asks the students to use a planetarium simulation program to model the motions of the Earth, Moon, and Sun to fully understand their relationship to one another. The students then use this knowledge to predict when eclipses will occur and explain why they happen and how they vary. The students then use the program to model specific eclipses to test their ideas. The more sophisticated computer modeling is also supplemented by different size Styrofoam balls that the students use to construct a 3D model that they can manipulate and discuss.

Another experiment provides the students with a number of lenses and filters that they experiment with to determine the rules of geometrical optics. They then use this knowledge to construct and test a simple telescope.

4. Students will understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.

Student activities encourage both descriptive and quantitative reasoning, spatial visualization, and ongoing exploration. A combination of experimentation, modeling, and observation exposes students to different investigative techniques and encourages them to seek connections that strengthen their conclusions. Class and individual discussions emphasize scientific questioning and creative thinking.

5. Students will understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.

Experimental labs require students to take measurements, analyze data, formulate conclusions, and make predictions. These labs focus on understanding general physical principles that are fundamental in astronomy.

VII. Syllabus: Paste syllabus below or attach and send digital copy with form. The syllabus should clearly describe how the above criteria are satisfied. For assistance on syllabus preparation see: [http://teaching.berkeley.edu/bgd/syllabus.html](http://teaching.berkeley.edu/bgd/syllabus.html)

*Please note: As an instructor of a general education course, you will be expected to provide sample assessment items and corresponding responses to the Assessment Advisory Committee.*