

**PHY102: Astronomy, Cosmology and Astrophysics**  
**Gustavus Adolphus College**                      **Fall Semester 2009**

**Instructor:** Dr. Charles Niederriter

**Office:** Olin Hall 211

**Office Hours:** MTWRF 8:00 AM – 9:00 AM

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**Textbooks (Required):**

- *The Cosmic Perspective, Fifth Edition* by Bennett, Donahue, Schneider and Voit, ©2008, Pearson Addison-Wesley
- *PHY102 Lab Manual Fall 2009*, by Steve Mellema and Chuck Niederriter
- *Star and Planet Locator*, from Edmund Scientific

**Course Objectives:**

This course is designed to illustrate the methods used by scientists (particularly astronomers) and to describe how these methods have changed over the course of history. The student will learn about the relationships between observations and theories by studying examples from astronomy and physics. In this course we will also discuss the relationships between science and mathematics, science and religion, and science and society.

Students who successfully complete this course should be able to understand the processes involved in developing models and theories and those involved in testing models and theories. These students should also have a basic understanding of the motions and properties of the heavenly bodies, know how to observe these motions and properties, and know how to relate these observations to models and theories.

The student beginning this course will be expected to understand basic mathematical principles such as those taught in high school algebra and geometry. During the course of the semester, algebra and geometry will be used extensively to discuss physical processes. The student will also be introduced to some concepts in trigonometry to illustrate the connection between mathematics and science but the student is not expected to use trigonometry to solve any problems. It is hoped that over the course of the semester the math skills of most students will improve as a result of the assignments in this course.

1. Achieve an understanding of “how we know what we know” in science and in astronomy.
2. Come to an understanding of your own, personal position in the universe.
3. Examine the relationship between scientific knowledge and other types of knowledge.
4. Understand the social context of science, and astronomy in particular, both historically and contemporarily.
5. Learn critical thinking, quantitative reasoning and problem-solving skills and be able to apply them successfully to the solution of scientific problems.

Achievement of these objectives will be demonstrated through writings (answers to group problems, papers, exams, and lab reports) as well as participation in class discussions.

**Course Policy and Evaluation:**

1. **Lecture and Recitation:** The class will meet four days a week (MTRF) for lecture and discussion in Olin 103. Wednesdays will be reserved for laboratory in either 103 or 217,215, and 224 (as announced). The student will be responsible for reading the text before coming to class.

2. **Homework:** Homework will be assigned on a regular basis. Some will be turned in to the instructor, graded and returned. Homework should be neat and orderly. Late homework will be accepted at the discretion of the instructor with some loss of points. Some homework assignments will be administered using the [Mastering Astronomy](#) website associated with our textbook. These will be assigned periodically and will have fixed due dates/times. You should register at the [www.masteringastronomy.com](http://www.masteringastronomy.com) website as soon as possible using the Student Access kit that came with your textbook. Our Class ID is **PHY102F09**.
3. **Group Problems:** Frequently, students will work together, in assigned groups of 2-3 members, to cooperatively solve problems. Only one group solution will be submitted, with all group members receiving the same grade. There will be no make-up for group problems missed due to absence.
4. **Laboratory:** There will be fourteen required laboratory experiments as described on the following page. Students are also required to perform at least four observatory exercises.
  - a. **Pre-Lab Quizzes:** On days when a lab experiment is scheduled, there will be a pre-lab quiz based upon the lab handout for that experiment. This quiz will be administered via the [WebAssign](#) program on the World Wide Web. The quiz must be completed by each student before coming to lab, and the WebAssign assignment for that day will expire 15 minutes before lab begins, i.e. at 8:45 AM.
  - b. **Lab Experiments:** Attendance at lab experiments is required. Lab reports will only be accepted from those who signed the lab attendance sheet. Generally, the 50-minute lab period will be long enough for students to take the necessary data, but additional work time will be needed outside of class to finish the analysis and write the lab report.
  - c. **Evening Observing Labs:** Each student will also be required to complete four evening observing laboratory exercises, one during each month of the semester. Due dates are listed on the following schedule for the observing exercises.
  - d. **Lab Reports:** Although lab work will be carried out in groups, each student must submit an individual lab report. While data will undoubtedly be shared among lab-group members, all calculations, conclusions and answers to questions are expected to be done by the individual submitting the report. Lab reports will be worth 10 points each for in-class labs and 20 points each for evening observing labs.
5. **Observing Sessions:** Observatory times will be scheduled for Sunday, Tuesday, and Thursday evenings (as weather permits). Students, working in groups of 2-3, will sign up for one or two 30-minute time slots (limit 4 groups per slot). Additional observing sessions will be scheduled occasionally and when needed.
6. **Attendance:** Regular attendance at all lectures and laboratories is expected and excessive absenteeism will result in some reduction of final grade. Participation is expected and is part of the students final grade.
7. **Extra-Credit Video Reports:** Throughout the semester, a series of videos will be presented in the evenings. Attendance is optional, but any student who attends a video presentation and submits a 1-2 page summary paper (**summarizing** the video and **relating** it to the course discussions) will receive extra credit of up to 5 points toward the next exam score. (Video extra credit points may not carry over past the next exam, and no exam score can ever exceed 100%.)

8. **Quizzes:** There will be several ten-minute quizzes throughout the semester based on the assigned reading.
9. **Exams:** There will be four one-hour exams during the course of the semester (see schedule below) and a two-hour, comprehensive final exam. Students must arrange **in advance** to take an exam at other than the scheduled time, and may do so **only** for a valid health or school-related reason. (It is the responsibility of the student to inform the instructor during the first week of the semester regarding any anticipated absences due to required field trips, athletic events, musical performances, or other extra-curricular activities.) Exams missed without pre-arrangement are entered as zero credit and cannot be made up.
10. **Email:** You may contact me by electronic mail; **chuck@gac.edu**. I will respond as soon as we can to any questions that you might have.
11. **Physics Tutors:** Limited tutoring for this course will be available at times announced in the departmental tutoring schedule.
12. **Office Hours, etc:** My scheduled office hours are 1<sup>st</sup> hour MTWRF. I will be available during these times for individual assistance and advising. I will also be available at other times by appointment. In general, if you want to stop in and you see me in the office, feel free to ask for help. If I can't help you then, I'll suggest some later time. Don't be afraid to ask for help.
13. **Academic Honesty:** Having signed and agreed to abide by the College's Honor Code, students thereby pledge that, in all academic exercises, examinations, papers, and reports, they shall submit their own work. In the context of this course, students are expected to collaborate and to discuss their out-of-class assignments. However, submitting under one's own name work that is merely copied from another is a violation of the Honor Code. (The full text of the Gustavus Academic Honor Code Policy may be found in the Gustavus Academic Bulletin 2005-2006, pp. 32-33).
14. **Disability Services:** Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (1990) work together to ensure "reasonable accommodation" and non-discrimination for students with disabilities in higher education. A student who has a physical, psychiatric/emotional, medical, learning, or attentional disability that may have an effect on the student's ability to complete assigned course work should contact the Disability Services Coordinator in the Advising Center (x6286). No accommodations can be made without review by the Disability Services Coordinator.
15. **Evaluation:**
- |                 |     |    |          |    |         |
|-----------------|-----|----|----------|----|---------|
| Exams           | 50% | A  | 94 - 100 | C+ | 74 - 78 |
| Lab Reports     | 15% | A- | 90 - 94  | C  | 70 - 74 |
| Pre-Lab Quizzes | 5%  | B+ | 86 - 90  | C- | 66 - 70 |
| Group Problems  |     | B  | 82 - 86  | D+ | 62 - 66 |
| & Quizzes       | 15% | B- | 78 - 82  | D  | 58 - 62 |
| Homework        | 15% | F  | 0 - 58   |    |         |
16. Assignment of final letter grades will also take into account the instructor's subjective evaluation of the student's attendance, initiative, class participation, preparation, and evidence of improvement.
17. **Incompletes:** A grade of incomplete will **only** be given for work not completed due to circumstances beyond the control of the student (*this is the College policy*).

## 18. Course Content and Tentative Schedule:

<u>Week Of</u>	<u>Text Sections Covered</u>	<u>Reading Assignments</u>
September 7	Chapters 1, 2	Chapter 1, 2, & Lab 1
September 14	Chapters 3, & S1	Chapter 3, S1 & Lab 2
September 21	Chapters 4 & 5	Chapter 4, 5, & Lab 3
September 28	Chapters 6 & 7	Chapters 6, 7, & Lab 4
<b>September 29 *** Exam 1 on Chapters 1 - 6 ***</b>		
<b>October 2</b>	<b>==== First Observing Exercise Due =====</b>	
October 5	Chapters 8 & 9	Chapters 8, 9
<b>October 6 &amp; 7 ****Nobel Conference – No Class &amp; No Lab ****</b>		
October 12	Chapters 10, & 11	Chapters 10, 11, & Lab 6
October 19	Chapters 12 & 13	Chapters 12, 13, & Lab 5
<b>October 23</b>	<b>*** Exam 2 on Chapters 7 - 13 ***</b>	
<b>October 23</b>	<b>==== Second Observing Exercise Due =====</b>	
<b>October 26 &amp; 27 ***** Fall Break or Reading Days (your choice) *****</b>		
October 26	Chapters S2, & S3	Chapters S2, S3, & Lab 7
November 2	Chapters S4 & 14	Chapters S4, 14, & Lab 8
November 9	Chapters 15 & 16	Chapters 15, 16, & Lab 9
<b>November 13</b>	<b>*** Exam 3 on Chapters S2, S3, S4, &amp; 14 ***</b>	
November 16	Chapters 17 & 18	Chapters 17, 18, & Lab 10
November 23	Chapters 19	Chapter 19
<b>November 24</b>	<b>==== Third Observing Exercise Due =====</b>	
<b>November 25 – 28 ***** Thanksgiving Break *****</b>		
November 30	Chapters 20, & 21	Chapters 20, 21, & Lab 12
December 7	Chapters 22, & 23	Chapters 22, 23 & Lab 13
<b>December 8</b>	<b>*** Exam 4 on Chapters 15 - 21 ***</b>	
December 14	Chapters 24 & Review	Chapter 24 & Lab 14
<b>December 17</b>	<b>==== Fourth Observing Exercise Due =====</b>	
<b>December 17 10:30 am *** Final Exam - Partly Comprehensive &amp; Partly Chpts. 22-24 ***</b>		

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**Laboratory Schedule**

<u>Due Date</u>	<u>Exercise</u>	<u>Title</u>
September 9	Lab 1	Observation and Star Chart
September 16	Lab 2	Introduction to <i>Voyager: Skygazer</i>
September 23	Lab 3	Introduction to Spectroscopy
September 30	Lab 4	Lenses and Telescopes
October 14	Lab 6	Rotation of Mercury
October 21	Lab 5	The Moons of Jupiter
October 28	Lab 7	Discovery of Extrasolar Planets
November 4	Lab 8	Solar Energy Flow
November 11	Lab 9	Photoelectric Photometry of the Pleiades
November 18	Lab 10	Classification of Stellar Spectra
December 2	Lab 12	The Hubble Redshift-Distance Relation
December 9	Lab 13	The Quest for Object X
December 16	Lab 14	The Large Scale Structure of the Universe (in class)
<b>December 16</b>	<b>Lab 11</b>	<b>Radio Astronomy of Pulsars (Extra Credit)</b>
October 2	Observing Experiment 1	Observing the Night Sky
October 23	Observing Experiment 2	Observing the Planets
November 24	Observing Experiment 3	Astrophotography
December 17	Observing Experiment 4	CCD Imagery