PHY 111

INTRODUCTION TO ASTRONOMY

Instructor: Dr. Martin Veillette
Office: Science Hall, Room 111
Phone: 985-3299
Email: veillette@berea.com
Office Hrs: MWF 2:00-3:00 p.m. or by appointment.
Website: http://moodle.berea.edu/course/view.php?id=272
Lecture Schedule: MWF 1:00-1:50 a.m. in room 019 SC
Lab Schedule: Tuesday 10:00-11:50 am in Room 027 SC

Prerequisite: MAT 012

CATALOG DESCRIPTION

This course will explore topics in modern astronomy, including the formation of the solar system, the lives and deaths of stars, the structure of the galaxy, and the origin and evolution of the universe. Both lecture and lab will emphasize a hands-on approach to understanding the underlying physical principles that govern astronomy. Three one-hour lecture periods and one two-hour laboratory each week. Practical Reasoning with Quantitative Emphasis (PRQ). Course Fee: $20.

COURSE INTRODUCTION

Astronomy is the science dealing with the sky, the universe and all its contents. Astronomy draws from physics, chemistry, geology, and even biology, but tends to have more of a big-picture focus than any of the other physical sciences.
Astronomy is one of the most ancient of the sciences, and was practiced in antiquity by cultures as diverse as the Babylonians, Egyptians, Greeks, and Mayans. Although the sky has changed little over the past few thousand years, man’s interpretations of what he sees has changed greatly. We will explore the history of astronomy and thus the changes in mankind’s thinking about the universe.

We will explore the sky and the motions of those objects visible to the unaided eye. We will move on to discuss the nature of stars and their lifecycle. We will explore the galaxies in which stars reside.

No scientific or mathematical background is assumed beyond the entrance requirements to the college. Astronomy is a science, however, so you will be expected to develop your critical thinking skills in order to understand and apply the scientific method. Modern astronomy is based on both physics and mathematics. Students are advised that this course will require a good working knowledge of basic algebra (after all this class satisfies the Practical Reasoning with Quantitative Emphasis (PRQ) requirement).

COURSE OBJECTIVES

This class is an overview of astronomy for non-science majors. We will cover most of the material in the Seeds textbook, following roughly the same order of topics. In addition to lecture, we will have in-class activities and short writing assignments, which are designed to help you learn collaboratively. We will use some basic algebra to solve problems, and a calculator is allowed on all exams. The overreaching goals are for you to understand the nature of science through astronomy, understand the big ideas in astronomy, and develop a lifelong interest in astronomy and current events surrounding astronomy.

Please feel free to make comments, criticisms, or suggestions at any time. I will make any adjustments that are necessary to ensure that you find the course both challenging and rewarding.

By completing this course, students are expected to:

- Have a basic understanding of modern theories of astronomical objects including planets, stars, galaxies, and the universe itself, including their composition, motion, origin, and evolution.
- Appreciate how explanations of astronomical objects have changed over the past 3,000 years.
- Understand the scientific method and its applications in astronomy.
- Know the difference between the scientific method and other means of inquiry.
- Be able to solve problems in astronomy using mathematical reasoning.
- Appreciate the notion that the world is knowable, that we may learn about it through observations, experiments, and theory via the scientific process.
- Appreciate the notion that physical laws are universal, with the behavior of the largest objects in the universe governed by the behavior of its smallest objects, such as atoms and electrons.
- Be familiar with the night sky and how its appearance changes with time and position.
• Have a basic understanding of how we measure the mass, temperature, brightness, composition, distance, and motion of stars.
• Understand how matter is grouped in galaxies, and of the evidence that most matter cannot be seen with light.
• Understand of how stars, galaxies, and the universe itself change with time, of how we know, and of what we still don't know.
• Be able to critically analyze arguments from a scientific perspective

REQUIRED TEXTBOOKS/MEDIA

  Alternatively you can buy an eTextbook (with a 180-day subscription)
• A scientific calculator (good inexpensive choices are Casio FX-260 or Texas Instrument TI-30XA)

COURSE REQUIREMENTS AND GRADING

Your final grade will be based on the following work:

Weekly assignments and Online Quizzes:
The material in the course cannot be learned passively. However reasonable, simple, or rational you may find what you read or hear, you do not understand it if you cannot apply it yourself. Thus it is imperative that you test yourself by doing problems. If you have difficulty with a problem, ask your instructor or your fellow students about it; do not suppose that your difficulty will cure itself without treatment. Therefore, the homework assignments and quizzes are primarily a learning tool, not a grading tool. Their purposes are threefold:
• To allow the instructor to see how you are doing and to try to correct errors you are making;
• To give you a chance to see the errors you are making and to correct them.
• To give you practice in explaining the concepts and using the techniques you learn in the course;

Late homework will be accepted only if you have made prior arrangements and there is a very good reason for being late. The online quizzes are due before class. You may attempt a quiz as many times as you wish before its due date.

Labs
Laboratory activities provide experience with phenomena, a starting place for the systematic development of ideas, and a testing ground for the predictive power of their reasoning. For students to acquire the manual and mental skills associated with learning astronomy, it is essential that they be fully engaged in laboratory activities. We will add hands-on experiences and lab experiments for you to gain a different understanding of astronomy. Each is carefully designed to help you learn about a particular scientific/astronomy concept, so they are not simply “fun”. These laboratories are all geared toward the non-scientist and will closely parallel the material seen in class. You will often need to bring your laptop. A lab report/worksheet will be due after each lab.

Class participation:

Throughout the semester, several in-class inquiry-based activities will be assigned to help you develop your critical thinking skills and practice fundamental astronomical concepts. Some of these activities may involve completing worksheets and will be collected and counted toward your final grade. There will be no make-up opportunity for the group problems, although copies of the assignment will be made available for study.

Observing sessions:

We will have several nights where the campus observatory is reserved for our class. You are required to attend at least two of these observing sessions and complete the observing worksheet that will be given to you when you arrive.

Exams:

As the schedule specifies, you will be given an in-class exam after every major section. While material on exams is drawn most from class lectures, we will assume that you have read and understood the assigned readings and will be able to them to fill in details not covered in lectures. We will have four in-class midterms and one final exam. The final exam will be cumulative and similar in format to the four in-class exams you took during the term. It will emphasize the most important concepts covered. There are no make-up exams. If you miss an exam due to an extenuating circumstance and can provide documentation, you may discuss with your instructor the possibility of writing a term paper in place of the missed exam.

CALCULATING YOUR FINAL GRADE

Your final course grade will be weighted as follows:

Break down of Grades:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly assignments</td>
<td>18%</td>
</tr>
<tr>
<td>Lab reports</td>
<td>16%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Observing Sessions</td>
<td>5%</td>
</tr>
<tr>
<td>Class participation</td>
<td>5%</td>
</tr>
<tr>
<td>In-class exams</td>
<td>30%</td>
</tr>
<tr>
<td>Final exam</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

A         93 – 100 %
A-        90 – 92.9 %
B+        87 – 89.9 %
B         83 – 86.9 %
B-        80 – 82.9 %
C+        77 – 79.9 %
C         73 – 76.9 %
C-        70 – 72.9 %
D+        67 – 69.9 %
D         63 – 66.9 %
D-        60 – 62.9 %
F         Below 60

**APPROVED LIST OF READING BOOKS**

If you miss an exam due to an extenuating circumstance and can provide documentation, you may discuss with your instructor the possibility of writing a term paper, based on one the books listed below, in place of the missed exam. In addition, the lowest score of your four in-class exams can be dropped upon satisfactory completion of book reading and oral interview. Additional information will be provided in class.

2. *Celestial Treasury: From the Music of the Spheres to the Conquest of Space.* By Marc Lachieze-Rey, et al. (Cambridge, 210 pp, 2001)
9. *1, 2, 3, Infinity: Facts and Speculations of Science.* By George Gamow (Dover, 335 pp, reprint)
12. *The Universe in a Nutshell.* By Stephen Hawking (Bantam, 224pp, 2001)

**STUDENT EXPECTATIONS AND COMMON COURTESY GUIDELINES**

Students and faculty each have responsibility for maintaining an appropriate learning environment. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

All students are expected to attend class regularly, participate in group activities and discussions in class, complete the homework assignments neatly and on time, attend all exams, and communicate with the instructor about any questions about the course requirements or material.

Please show respect for everyone’s learning environment. If you arrive late, enter the room quietly. If you anticipate needing to leave the room in the middle of class, sit near an exit. Do not eat, conduct off-topic discussions, or sleep during class. Leave your cell phone or pager OFF. Students who frequently disrupt class will be asked to leave.

If you want to use a calculator on exams, you need to bring one that is not part of your cell phone (most cell phone calculators can’t handle the problems we’ll be doing anyway).

For the benefit of your fellow students and your instructors, you are expected to practice common courtesy with regard to all course interactions. For example:

- Show up for class on time.
- Turn off your cell phones before class begins!
- Do not leave class early, and do not rustle papers in preparation to leave before class is dismissed.
- Be attentive in class; stay awake, don’t read newspapers, etc.
- If you must be late or leave early on any particular day, please inform your instructor or TA in advance.
- Play well with others. Be kind and respectful to your fellow students and your teachers.
Those who fail to adhere to such behavioral standards may be subject to discipline.

**TENTATIVE SCHEDULE**

Listen in class and check Moodle for updates to the schedule.

<table>
<thead>
<tr>
<th>Week</th>
<th>Start of Week</th>
<th>Textbook Chapter</th>
<th>Readings</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug. 23</td>
<td>1</td>
<td>Introduction and Fundamentals</td>
<td>Introduction</td>
</tr>
<tr>
<td>2</td>
<td>Aug. 30</td>
<td>2</td>
<td>Motions of the Night Sky</td>
<td>Solar System Models</td>
</tr>
<tr>
<td>3</td>
<td>Sep. 6</td>
<td>3</td>
<td>Cycles of the Moon</td>
<td>Lunar Phases</td>
</tr>
<tr>
<td>4</td>
<td>Sep. 13</td>
<td>4</td>
<td>Origins of Modern Astronomy</td>
<td>Motion of the Sun</td>
</tr>
<tr>
<td>5</td>
<td>Sep. 20</td>
<td>5</td>
<td>Gravity</td>
<td>Planetary Orbit</td>
</tr>
<tr>
<td>6</td>
<td>Sept. 27</td>
<td>6</td>
<td>Light and Telescopes</td>
<td>Photometry of the Sun</td>
</tr>
<tr>
<td>7</td>
<td>Oct. 4</td>
<td>7</td>
<td>Starlight and Atoms</td>
<td>Spectroscopy</td>
</tr>
<tr>
<td>8</td>
<td>Oct. 11</td>
<td>8</td>
<td>Observing the Sun</td>
<td>Blackbody Radiation</td>
</tr>
<tr>
<td>9</td>
<td>Oct. 18</td>
<td>9</td>
<td>The Family of Stars</td>
<td>Stars and the Hertzsprung-Russell Diagram</td>
</tr>
<tr>
<td>10</td>
<td>Oct. 25</td>
<td>10</td>
<td>Interstellar Medium</td>
<td>Parallax Method</td>
</tr>
<tr>
<td>11</td>
<td>Nov. 1</td>
<td>11</td>
<td>Formation and Structure of Stars</td>
<td>Cluster Color-Magnitude Diagrams</td>
</tr>
<tr>
<td>12</td>
<td>Nov. 8</td>
<td>12</td>
<td>Stellar Evolution</td>
<td>Atmospheric Retention</td>
</tr>
<tr>
<td>13</td>
<td>Nov. 15</td>
<td>13</td>
<td>Life Cycles of Stars</td>
<td>Variable Star Photometry</td>
</tr>
<tr>
<td>14</td>
<td>Nov. 22</td>
<td>14</td>
<td>Neutron Stars and Black Holes</td>
<td>Thanksgivings</td>
</tr>
<tr>
<td>15</td>
<td>Nov. 29</td>
<td>15</td>
<td>Milky Way Galaxy</td>
<td>Hubble Galaxy</td>
</tr>
<tr>
<td>16</td>
<td>Dec. 6</td>
<td>16-17</td>
<td>Classifying Galaxies and the Hubble Deep Field</td>
<td>Hubble Law and the Age of the Universe</td>
</tr>
<tr>
<td>17</td>
<td>Dec. 13</td>
<td></td>
<td>Final Exam (comprehensive)</td>
<td></td>
</tr>
</tbody>
</table>

**TENTATIVE SCHEDULE: EXAMS**

<table>
<thead>
<tr>
<th>Exam</th>
<th>Day</th>
<th>Textbook Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wednesday Sept. 22</td>
<td>1, 2, 3 and 4</td>
</tr>
<tr>
<td>2</td>
<td>Wednesday Oct. 13</td>
<td>5, 6, and 7</td>
</tr>
<tr>
<td>3</td>
<td>Monday Nov. 8</td>
<td>8, 9, 10, and 11</td>
</tr>
<tr>
<td>4</td>
<td>Monday Dec. 6</td>
<td>12, 13, 14, and 15</td>
</tr>
<tr>
<td>Final</td>
<td>Wednesday Dec. 15</td>
<td>Comprehensive Exam</td>
</tr>
</tbody>
</table>

**TENTATIVE SCHEDULE: NIGHT LABS**

<table>
<thead>
<tr>
<th>Night</th>
<th>Day</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wednesday Sept. 15</td>
<td>Using the Planisphere</td>
</tr>
<tr>
<td>2</td>
<td>Thursday Oct. 7</td>
<td>Observing the Moon and Planets with Telescopes and Binoculars</td>
</tr>
</tbody>
</table>

**ACADEMIC DISHONESTY**
Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript, and/or suspension or expulsion from the university. For more information on the various kind of academic dishonesty please refer to the College’s statement on academic integrity located online in the Berea College student Handbook. The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which credit has been obtained;
- improper collaboration in group work;
- copying or using unauthorized aids in exams and examinations. In plain language this means that exams have to be the result of individual work.

In the event a student is found to be guilty of cheating or plagiarism in a particular homework assignment or an exam that particular work will not be accepted and a report will be filed with Associate Dean of Academic Affairs. If at any time you are unsure of how to avoid plagiarism you should contact the instructor or the Learning Center for guidance.

**LAPTOP COMPUTERS AND OTHER ELECTRONIC DEVICES**

Laptop computers are not required for the lecture portion of the course. You may use your laptop for note-taking during lecture if you so choose. Game-playing is prohibited during classes. Cell phones, pagers, and other such devices should be turned off or put into silent mode. Students with special considerations should make arrangements prior to class. You will not be permitted to use the calculator on your cell phone during an exam.

**ATTENDANCE POLICY**

It is mandatory for every student to be present and on time for all classes. You are expected to come to the class on time. Attendance in classes will be recorded. Late attendance will not be tolerated and will be counted as a ½ absence. Missing more than 5 periods (for any reason) will lower your class grade by one third of a letter grade; missing more than 10 class periods (for any reason) will result in a failing grade.

**FEEDBACK**

The Office of Institutional Research and Assessment will administer an instructor evaluation questionnaire in an electronic format. I expect you to participate in the evaluation process. Your input will be anonymous and be used in to improve the teaching effectiveness of the instructor and the learning process of the student. You will receive instructions by email from the office of Institutional research at the end of the semester about how to proceed with the evaluation. However, you are welcomed to give feedback directly to the instructor at any point in the semester.
STUDENT SPECIAL NEEDS SERVICES

If anyone in this class is in need of special academic accommodations and is already registered with the Special Needs Services Office, please make an appointment with the course instructor to discuss such accommodations. Upon request, this syllabus can be made available in alternative forms. If you have a disability that may prevent you from duly demonstrating your ability and are not already registered with the special needs services, you should contact the Disability Services Coordinator at (859) 985-3212 to discuss accommodations necessary to ensure your full participation in this course.

RELIGIOUS OBSERVANCES

The instructor shall make every effort to accommodate all students who, because of religious obligations, have conflicts with scheduled exams, assignments, or other required attendance, provided they notify you well in advance of the scheduled conflict. Whenever possible, students should notify faculty at least two weeks in advance of the conflict to request special accommodation. If an exam is scheduled on a religious holiday, the instructor will provide a suitable option for the affected student. If the student and the course instructor cannot agree on an accommodation, the student may bring the matter to the Department Chair for a decision.

DISCRIMINATION AND SEXUAL HARASSMENT

All faculty members and students are expected to conduct themselves in accordance with the high human and spiritual values that arise from the College’s commitments and traditions. The College is committed to study, reflection, work, and social interaction which manifest these high values and foster healthy human and spiritual development. This requires an environment of mutual respect free of religious, racial, or sexual discrimination and free from harassment. Any student who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion or sexual orientation should contact the Academic Affairs.

CAN I GET THE GRADE I REALLY WANT?

Yes—but it will depend on your effort. It does not matter whether you have even learned anything about astronomy before or whether you are “good” in science. What does matter is your willingness to work hard. Astronomy is a demanding course in which we will move quickly, and each new topic will build on concepts covered previously. If you fall behind at any time, you will find it extremely difficult to get caught up. If you want to get a good grade in this class, be sure to pay special attention to the following:

- Carefully read the section in the preface of your textbook called How to Succeed in Your Astronomy Course. It describes how much time you should expect to spend studying outside class and lists a number of useful suggestions about how to study efficiently.
• When you turn in assignments of any kind, make sure they are done clearly and carefully. Refer to the separate handout Presenting Homework and Writing Assignments.
• Don’t procrastinate. The homework assignments will take you several hours, so if you leave them to the last minute, you’ll be in trouble—and it will be too late for you to ask for help. Both quizzes and homework need to be completed on time if you want to avoid late penalties.
• Don’t miss class, and make sure you come to class prepared, having completed the assignments due by that date.
• Don’t be a stranger to your instructor—come see me during office hours, even if you don’t have any specific questions.
• If you find yourself confused or falling behind for any reason at any time, let me know immediately! No matter what is causing your difficulty, I am quite willing to work with you to find a way for you to succeed—but I can’t help if I don’t know there’s a problem.

A CLOSING PROMISE

All the hard work described above might sound a bit intimidating, but I can make you this promise: Few topics have inspired humans throughout the ages as much as the mysteries of the heavens. This class offers you the opportunity to explore these mysteries in depth, learning both about our tremendous modern understanding of the universe and about the mysteries that remain. If you work hard and learn the material well, this class will be one of the most rewarding classes of your college career.