When you look at the stars and the galaxy, you realize that you are not just from any particular piece of land, but from the Solar System. – Kalpana Chawla, one of seven astronauts who died aboard the shuttle Columbia on 1 February 2002

TWO COURSES, ONE SYLLABUS? We offer two different variants of introductory astronomy at Middlebury. PHYS 0155, “An Introduction to the Universe,” is a course we have taught for many years. It has no pre-requisites and is intended to provide a conceptual understanding of how stars, galaxies, and the Universe work, and how people have learned about them (and continue to do so). PHYS 0165, “Physics in the Universe,” is intended primarily for students who would prefer the deeper understanding of many cosmic phenomena that can be achieved through using a bit more physics and mathematics. PHYS 0165 has the pre-requisite of strong high-school physics, or PHYS 0109, or equivalent, plus a little calculus. Students who wish to take upper-level physics or astronomy courses later would do better to enroll in the PHYS 0165 version now. Not sure which is for you? Start by registering for either version, and come to the first one or two section meetings for PHYS0165. You can switch (either way) easily during the first few weeks of the term.

INSTRUCTOR: Frank Winkler MBH 526 Ext 5426
Office Hours: Mon. and Wed. 2:30–4:00 pm. I am frequently around other afternoons. I will often communicate with the class by email. Check your email regularly for schedule updates, etc.

LECTURES: MWF, 11:15 - 12:05, MBH 216 (common to both courses)
I’ll try to start and end on time. Announcements about schedule, assignments, etc. will be on the board at the start of class, and I’ll be available for questions about mechanical stuff like this before and after class. (Questions on the material are fair game any time.) Please help us make most effective use of the period by being on time.

LAB/DISCUSION SECTIONS: Each of you who is registered for the course should also be registered for one of the following sections. If you are adding, or if you have a conflict with your original section, we will work out final section assignments during the first week of classes. It is generally possible to come to a different section occasionally.

W: Mon, 7:30–9:30 pm
X: Tues, 7:30–9:30 pm
Y: Wed, 7:30–9:30 pm
Z: Thur, 7:30–9:30 pm

MBH 503 is the nominal meeting place for labs, and they will always start there unless announced otherwise. When the weather is clear we’ll usually go to the 7th floor observing deck and/or the Observatory dome. Be on the lookout for updates and changes, announced in lecture and/or in handouts and/or by email.

OBSERVATORY: Is located atop Bicentennial Hall. Take the stairs or elevator to level 7. From there you can go out onto the roof deck, which we use for observing with several
small telescopes and binoculars, as well as for naked-eye observing. To reach the dome, take the staircase up from the 7th floor. The observatory, and of course the open roof deck, are unheated. Even when it has been warm during the day, the temperature can drop significantly on clear evenings, and one can get pretty chilly while standing around and doing a lab. Please come to lab dressed appropriately for outdoors.

**PHYS 0165 DISCUSSION:** There will be an additional discussion section, meeting Tuesdays from 1:30 to 2:45 in Bi Hall room 538, for **PHYS 0165 students only**. In it we will introduce supplementary topics, take a more mathematical approach to some course material, and have an opportunity for more extended discussion. All PHYS 0165 students should plan to attend this section in addition to lectures and one lab section.

**REQUIRED BOOKS AND OTHER MATERIALS:**

The first of these, *The Cosmic Perspective*, is the primary text and will most closely overlap, and serve as a backup for, the lectures. The reserve readings (on both electronic and regular reserve) provide enrichment and extensions. Required readings will be assigned from all of these.


An excellent, comprehensive textbook authored by an enthusiastic group of young astronomers. While we won’t begin to cover every chapter or page in lectures, most of what we’ll discuss in class is somewhere in the text. This is the same text as was used last year. A number of good used copies are in the bookstore. You may also find copies of the 5th edition may also be available, but some of the material, as well as the page numbers and even some chapter numbers, are different from the current edition. A CD-ROM, *Voyager Sky Gazer*, should be included with the text, and this will be useful; if you buy a used text, be sure the CD-ROM is included.

*The Night Sky*: A nifty star chart for learning your way around the night sky. Buy one, and bring it to lab with you! And write your name on it—every year a few get lost.

**Electronic Reserve materials.** There will be several assigned readings available through the E-reserve system of the library; available on-line directly at [http://eres.middlebury.edu/eres/coursepage.aspx?cid=1032](http://eres.middlebury.edu/eres/coursepage.aspx?cid=1032). Or follow the library links for E-reserves, and search for “PHYS0155” or “winkler” to access this course. Either way, the password is **2195fw**. Most of these are selections from books or articles by leading astronomers responsible for key discoveries—from Galileo to the present day. All these materials and more will also be available in hard copies at the Reserve Desk in the Armstrong Science Library.

For more information on the **constellations**, you might want to get the following; a few copies are in the bookstore, and more can be ordered. This is entirely optional; if you want to learn more about the constellations, this is the best short, inexpensive guide I know.


**Other Materials:** You should also have a **flashlight** and bring it with you to night labs. A red filter will enable you to use your flashlight without affecting your night vision; we’ll have some red gel material available in lab so you can make one. It will be useful to have a **notebook**, for recording your observations of the sky, and also for keeping track of the lab information sheets and numerous other handouts that will be distributed over the term. I
suggest an inexpensive 8 1/2 x 11-inch 3-ring binder; bring it to lab with you each week. Binoculars make the sky richer, if you happen to have a pair, but these are entirely optional.

ASSIGNMENTS:
There will be weekly assignments designed to help you increase your understanding of things astronomical. These will normally be due on Fridays. Note that there will often be different (at least in part) assignments for PHYS 0155 and PHYS 0165; those for PHYS 0165 may be somewhat more mathematically oriented. Assignments should be handed in to the slot labeled “PHYS 0155/165 Ass’ts” on the 5th floor, opposite room 525 and just past my office. Papers will be returned to the mailboxes outside the lab room (503). Answers to most of the questions or problems will be placed in a binder at the reserve desk in the Armstrong Science Library (entrance on the second floor of Bi Hall). In addition to being passed out in class, all the assignments, and most other handouts, will also be available on the server: middfiles/classes, in folder Fall11 --> PHYS0155A --> HANDOUTS/ASSIGNMENTS. Also in the HANDOUTS folder you will find copies of almost all transparencies shown in lecture, in the TRANSPARENCIES subfolder; similarly for labs.

DROP-IN HELP SESSIONS: We will schedule drop-in sessions where students may work together on assignments or labs, with one of our Teaching Assistants (TAs) available as a resource. These will be in the 5th floor study/lounge (overlooking the Great Hall) adjacent to the lab room, 503. These are tentatively scheduled for Thursday evenings, 9-10:30 pm, and Friday afternoon, 2:45-4:15 pm; this could change, and if so we’ll announce that by email and in class. If you find yourself confused, or simply would like to talk over course material with a TA or other students in the course, please take advantage of this resource!

LAB and OBSERVING EXPECTATIONS:
Each of you will be expected to complete eight observing or lab exercises over the course of the term. You may select these from a “menu” including a number of observational projects: some naked-eye, some telescopic. Some of these can be done easily in a single evening, some require short observations extending over several days, and one involves a low level of effort over much of the term. There is no substitute for experiencing the sky first hand, either with the naked eye or through a telescope. Our observing exercises are designed to make the night sky more familiar to you, to help you place the myriad objects we’ll be studying in their natural context, and to develop your appreciation for how astronomers glean information. When it’s clear, we’ll use the night labs both for actual observations and to orient you for observations you can do on your own. There are also a couple of exercises that must be done during the daytime.

In addition to observing exercises, there will be a few that we’ll do in the laboratory, and perhaps some that will involve computer simulations. These we’ll usually do during the scheduled laboratory periods.

Which exercises from our menu that you choose to do will be up to you. Everyone will be expected to complete and hand in at least one observing lab by October 3 and at least four labs (total, including your first) by October 31. The sheet “Laboratory and Observing Requirements” describes all this in detail. Our skies are still quite dark here in rural Vermont, a real asset, but unfortunately you’ll also find that it’s typically cloudy more evenings than not. It will be up to each of you to keep an eye on the weather, and to make your observations when the opportunity comes. Procrastinators take note: the weather in November and December is typically much cloudier than in September and October. Carpe Noctem!
GENERAL COMMENTS ON ASSIGNMENTS AND LABS:

All written work for this course should be done neatly, correct in spelling and (for prose) grammar. Diagrams often contribute to clarity of thinking and presentation, and you should feel free to include them whenever you feel it is appropriate. For calculations, you should always include the units that go with any number, and be careful and explicit in converting units—that’s the most common sort of error people make. Neat, legible handwriting is fine; there is no reason to type assignments unless it’s easier for you or your handwriting is illegible.

PLAGIARISM AND THE HONOR CODE:

For assignments in this course, I permit and encourage you to discuss the ideas with your classmates. The written work you hand in, however, should represent your own expression of those ideas, even if they arose in part from discussions with others. Copying or paraphrase, without acknowledgment, from the work of a classmate or from any published or unpublished source is not acceptable. Whenever you’ve discussed an assignment with others to any significant extent, you should indicate the names of people you have worked with on your paper. There is no penalty for this; it’s simply sound practice. This policy applies to all written work, including assignments and lab reports.

Please note that the policy on discussion or collaboration may be different in other courses, and you should consult with the instructor of the course if you have any questions whatever.

The fabrication of data—whether an entire data set or a single observation or data point, or the use without explicit acknowledgement of data you did not take yourself, is academic dishonesty, an extremely serious offense that you must scrupulously avoid.

MATHEMATICS:

PHYS 0155 is not a course involving mathematical analysis; rarely will you be asked to use anything beyond the most elementary algebra and geometry. There are fewer than a dozen simple formulas that crop up over and over in many contexts; you’ll learn their significance, when and how to use them. I believe that all of these, plus a few more, are collected in about half a page as Appendix B of the Cosmic Perspective text. Also, since in astronomy we’ll be dealing with distances and sizes that are, well, astronomical, you’ll have to develop some facility in dealing with very big numbers. Doing numerical calculations and developing facility with scientific notation – general quantitative literacy—is important. (This course does fulfill the quantitative distribution requirement, by the way.) I hope you will learn to make quick, rough calculations and estimates without having to rely on a calculator, but your calculator will always be available to you. Appendix C of The Cosmic Perspective has an excellent discussion of virtually all of the mathematical skills that you’ll need for PHYS 0155.

Every year there are a few people who come to PHYS0155 fearful about mathematics. This may be because they’ve never really been taught (or otherwise developed comfort with) basic math skills, or because their last exposure to math was several years in the past. For people who count themselves among these, I’ll offer a once-a-week math “coaching” session. We will work on basic skills with the kinds of “word problems” that typically involve large numbers, and will focus especially on estimation and use of units. This is intended only for those with a real math anxiety; people who demonstrate good competence will “graduate” out of this group. If you think you may be one of these, PLEASE come see me, or send me an email, and we will schedule a time for the first meeting.
EXAMS:

There will be two mid-term exams, both scheduled for evenings, so you will not have time pressure. These will be Tuesday, **October 11** and Tuesday, **November 15**. An alternative time for each exam is the afternoon of the following day. If you must miss an announced exam due to athletic events or other conflicts, it is your responsibility to make arrangements with me ahead of time in order to make it up. In event of illness, you must obtain a make-up excuse from the Dean of Students office. The final exam is scheduled for **Wednesday, Dec 14, 7-10 pm**. Please take note of the final exam schedule for all courses before making travel plans for December. See: [http://www.middlebury.edu/academics/resources/scheduling](http://www.middlebury.edu/academics/resources/scheduling) (bottom of page)

GRADING:

Components of grades in **PHYS 0155** will be approximately:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Assignments</td>
<td>20%</td>
</tr>
<tr>
<td>Observations and Labs (first half)</td>
<td>15%</td>
</tr>
<tr>
<td>Observations and Labs (second half)</td>
<td>15%</td>
</tr>
<tr>
<td>Exams (2 Midterms + a Final; the final will count somewhat more than each midterm)</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Note that the exams all together count exactly half, and the labs and assignments count half. **The best way to assure you will do well in this course is to be diligent about completing your labs and assignments on time.**

For **PHYS 0165**, the structure of assignments, exams, and possibly some labs, will be different; the relative weighting will be different as well. Students in PHYS 0165 have the option of being excused from the Final Exam.

TOPICS COVERED and APPROXIMATE SCHEDULE:

1. Astronomy from the ancients to Newton; observing the night sky and (eventually) understanding celestial motions 3 1/2 weeks
2. Light and telescopes; physical phenomena and observational tools 1 1/2 weeks
3. How stars work—our Sun and others. Their life histories, and how astronomers learn about them 3 weeks
4. Stellar necrology: how stars die as pulsars, black holes, supernovae, etc. 1 week
5. The Galaxy we live in; other galaxies near and far; the expanding Universe 1 1/2 weeks
6. Cosmology: the past and future of the entire Universe; Life in the Universe 1 1/2 weeks
## PHYS 0155/0165 Calendar, Fall Term, 2011

<table>
<thead>
<tr>
<th>M</th>
<th>TU</th>
<th>W</th>
<th>TH</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/12 Classes Begin</td>
<td>9/13 1st PHYS0165 meeting, 1:30, MBH 538</td>
<td>9/14</td>
<td>9/15</td>
</tr>
<tr>
<td>3</td>
<td>9/26</td>
<td>9/27</td>
<td>9/28</td>
<td>9/29</td>
</tr>
<tr>
<td>4</td>
<td>10/3 One lab due by 5 pm today</td>
<td>10/4</td>
<td>10/5</td>
<td>10/6</td>
</tr>
<tr>
<td>5</td>
<td>10/10 Review Session, 7:30 pm, MBH 216</td>
<td>10/11 1st Midterm Exam, 7:30 pm, MBH 216</td>
<td>10/12 Alternate time for Midterm, 1:00 pm or later</td>
<td>10/13</td>
</tr>
<tr>
<td>6</td>
<td>10/17</td>
<td>10/18</td>
<td>10/19</td>
<td>10/20</td>
</tr>
<tr>
<td>7</td>
<td>10/24 Mid-Term Recess</td>
<td>10/25 Mid-term Recess</td>
<td>10/26 Classes Resume</td>
<td>10/27</td>
</tr>
<tr>
<td>8</td>
<td>10/31 Labs for first half of course (4 or more) due</td>
<td>11/1</td>
<td>11/2</td>
<td>11/3</td>
</tr>
<tr>
<td>9</td>
<td>11/7 Winter Registration</td>
<td>11/8</td>
<td>11/9</td>
<td>11/10 Round 1 Spring Registration</td>
</tr>
<tr>
<td>10</td>
<td>11/14 Review Session, 7:30 pm, MBH 216</td>
<td>11/15 2nd Midterm Exam, 7:30 pm, MBH 216</td>
<td>11/16 Alternate time for Midterm, 1:00 pm or later Spring Registration Begins</td>
<td>11/17</td>
</tr>
<tr>
<td>11</td>
<td>11/28 Classes Resume</td>
<td>11/29</td>
<td>11/30</td>
<td>12/1</td>
</tr>
<tr>
<td>12</td>
<td>12/5 Labs for second half of course (at least 3 of 4) due.</td>
<td>12/6</td>
<td>12/7</td>
<td>12/8</td>
</tr>
<tr>
<td>E X A M</td>
<td>12/12 Exam Period Begins</td>
<td>12/13</td>
<td>12/14 PHYS 0155 Final Exam, 7:00 pm, MBH 216</td>
<td>12/15</td>
</tr>
</tbody>
</table>