

KEENE STATE COLLEGE

ASTRONOMY 101 – ELEMENTARY ASTRONOMY Spring Semester, 2005

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Website: [HTTP://ACADEMICS.KEENE.EDU/RHARKAY/ASTROCLASS.HTML](http://academics.keene.edu/rharkay/astroclass.html) or link via physics Website from KSC main page under academics or from the Blackboard site for this class.

TEXT: Horizons, 8th ed. by Seeds; ASTRONOMY Web Page with Links ; Webtutor available online. Recommended (if available) Study Guide for Test, Astronomy Study Guide, by Harkay OR, rated highly by students, the study guide from the publisher for the Seeds text.

PHONE POLICY: Phone memos requesting course/help policy, exams provided for this purpose – please see me **in person** – voice mail use **limited** as outlined in class. I will be checking the Forum on our website regularly and answer questions there for all. If you have a more personal question, use my email link provided. I prefer that general procedural questions be asked at the start of the first few classes and, after that, via the forum, where other students can view the responses and peers can assist peers.

INCLEMENT WAETHER: As long as KSC is operating, we will hold class. Our class takes place at midday, when the roads are usually at their best, rather than early morning. Use your own judgment if you are a long-distance commuter. Missing a class due to hazardous roads will not count against attendance credit. If I know in advance that a class must be cancelled for any reason, I will announce this at an earlier date either in class or on Profnotes.

COMPUTER POLICY: Web access is REQUIRED for this course, as is the case for most at KSC. In addition, there are homework assignments which use the packaged SKY observatory software. Web assignments are posted on the above website, and the Profnotes link at that site provides me with a valuable tool for managing a large class-reminders, hints, items of general interest, topics covered, etc. It is important that you “stay tuned” to these reminders and not visit the course website just before exams. ALSO, a reminder about the internet and Profnotes in particular. Depending on how your computer is set up for caching viewed websites, you may see an old version of Profnotes when you visit again. You must hit the **refresh button** on your browser to obtain the most recently posted version! We also use the Keene Blackboard site, [HTTP://KEENE.BLACKBOARD.COM](http://keene.blackboard.com) as a host for our class forum, which I want you to take advantage of as a group and the publisher’s WebTutor study software. Access problems, if you have any, (particularly from on-campus labs or dorms) can be addressed by calling or emailing the helpdesk (HELPDESK@KEENE.EDU). I cannot fix your computer, but they can. If you are experiencing problems with internet assignments (particularly the “page cannot be displayed” message, please let me know right away so I can find a new link or determine if the site is permanently disabled - sometimes servers are down temporarily or links become broken. I check all links at the start of the semester, but sites come and go. It is advisable to do the internet work early in the section rather than waiting, as technical difficulties might arise. If you are working at home, IE5 will work for required browsing, but an upgrade is recommended. I hope that providing these resources helps you to master the material and provides a level of depth, currency, and interest which you find appealing. The planetarium CD is self-installing and I will demonstrate it in class, as KSC no longer has a planetarium. The vast majority of past students have reported that these planetarium assignments are not only “doable” but fun and make certain concepts much more easy to visualize.

HOMEWORK: end of chapters, as assigned, plus internet assignments and planetarium questions for each section. There are additional sets of questions on the website, but these are NOT for use with the present textbook.

The below represents the reading and homework for the semester (Web questions to be posted on the website):

**READING AND HOMEWORK
FOR ASTRONOMY 101. TEXT: SEEDS' HORIZONS, 8th ed.**

The professor reserves the right to modify the pace (it is an ambitious one!) if class performance, comprehension, class cancellations, etc. dictate the need to do so. Homework packets may be turned in **on day of exams for extra credit** as defined in the syllabus and discussed in class. Packets must be **at least 80% complete to be considered, neat, and stapled or clipped on clean paper**-they need not be word-processed. No DUPLICATE submissions accepted or graded, regardless of fonts used.

It is OK to work as a group, but each individual must word answers his/her own way. If you are working as a group, please indicate the members at the top, under your own name. Answers to homework questions **MUST** contain a portion of the question so it makes grammatical sense and I know what is being answered! In other words, something like "42" is unacceptable. Instead, "The answer to life and the universe is 42" (this is from a very old book/movie) is fine. You need not repeat the question-just include enough in the answer so I and/or a grader know what you are talking about. If you can answer the below representative questions, you probably have a great mastery of Astronomy 101 and will do well on exams. I hope you enjoy the course and good luck!

| WEEK | READING-TOPICS COVERED | HOMEWORK ASSIGNED |
|---------------|---|---|
| 1 | Introduction to astronomy | shadow stick (to be handed in at Exam 3) |
| 2,3 | ch. 1,2,3 Sky Motions, Coordinates Seasons, Moon Phases, Tides | 1: RQ 6,7,10, P 3,5,7,8,10 2: RQ 1,5,10,12,13; P 1,2,3,5 SKY 1,2 3: RQ 2,3,5,7,8,9; P 1,3,5 SKY 1,3 |
| 4 | ch 4 History of Astronomy Parallax, Kepler's Laws | 4: RQ 3,4,5,12,13; P 4,5 SKY 1,2 |
| 5 | Ch 5 Light and Telescopes | 5: RQ 1-5,7,10,11,14; P 1-3,5,6,8 |
| EXAM I | | |
| 6 | Ch6 Spectra, Doppler Shift | 6: RQ 1,4,5,6,8,11,13; DQ 1 P 2-6,8,10; SKY 1 |
| 7 | Ch7 The Sun, Sunspots, Fusion | 7: RQ 2,5,7,8,11,13,14,15 P 4,5,6,9 |
| 8 | Ch 8 Magnitudes II, H-R Diagram Ch 9 Fusion II, Starbirth | 8: RQ 1,2,5,6,7,9,12,14; P1, 3*,6,7 9,14; SKY 1 9: RQ 1,2,4,5,11-14; P 5,6,8,9,11 |
| 9 | Ch 10 "Death and Transfiguration" of Stars | 10: RQ 1,3,6,7,9-11,14; P 1,2,8 |

10 Ch 11 Neutron Stars, Black Holes 11: RQ 1-3,5,6,8,9,11,13,14; P 1,5
Gamma Ray Bursters

EXAM II

11 Ch 12 Milky Way, Variable Stars 12: RQ 2,3,6,-9,13,14; P 1,8,9;SKY 2,3
Ch 13 Galaxies 13: RQ 2,4,7-10,14; P 3,6; SKY 2

12,13 Ch 14 Supernovae I and II 14: RQ 8,10,11; P1
Ch 15 Hubble's Law and Cosmology 15: RQ 3-5,7,9,11; P 1,4

14 Ch 16 Origin of the Solar System 16: RQ 1,2,6,8,9,11,14; SKY 1,2
Ch 19-1, 19-3 Meteors and Comets 19: RQ 5,13,14; P 10
Ch 20-3 Life Elsewhere and Communication 20: RQ10,12

EXAM III

Finals Week-Comprehensive Final Exam

How to prepare for an exam:

1. Only **topics** presented or discussed in lecture will appear on the exam (although you will have to read the text to fully master the material). The text contains a great deal more material than we have time to cover. The text should be used to reinforce lecture material. Naturally, you are invited to read and enjoy as much of it as your time permits!
2. Answer assigned end-of-chapter questions. They are chosen to reflect material that receives the greatest emphasis. Attend review sessions if they are available. Use all resources provided, including study guides and on-line practice materials.
3. Practice the questions in my study guide (if made available) that relates to material covered in lecture.
4. Form study groups whenever you can.
5. If a sufficiently large group would like to have a review session prior to an exam, I (or an SI) will be happy to find a room and be available to help you.
6. Use the forum (on KSC Blackboard)! It is interactive and I add to the threads. Your peers will assist you as well. This is a great place to post questions when you get stuck on the homework or you are still puzzled by something I said in class.

Course objectives:

1. Introduce the student to science and scientific method.
2. Present an overview of astronomy comprehensible to students with little or no science background.
3. Instill in students an appreciation of Astronomy, both theoretical and observational.
4. Introduce the physical principles and methods of data acquisition associated with Astronomy.

Outcomes: the student shall –

1. Understand the observational effects of the motions of the earth, moon and planets.
2. Demonstrate a working knowledge of new terminology presented in Astronomy.
3. Understand the properties of bodies such as stars, planets, moons, comets, meteors, asteroids, nebulae and galaxies.
4. Understand the properties of light and how it provides astronomical information.
5. Be able to apply quantitatively fundamental physical principles and concepts to astronomical observations.
6. Gain an understanding of theories regarding the origin and make-up of the solar system and cosmos.
7. Understand and appreciate the uniqueness of and processes required to produce the Earth as a planet suitable for humans.

Methods of evaluation:

1. Three 1 hour examinations = 75% of grade.
2. Comprehensive Final Exam = 25% of grade.
- 3a. A semester project may be **substituted** for one exam.
- 3b. A **completed (at least 80%)** set of homework assignments from the chapter on which an exam is based may be submitted the day of the exam. The exam grade will be raised a **maximum of one letter grade**, depending upon quality/correctness of homework. It is OK to work in groups, but there shall be **no duplicate submissions! No partial credit for incomplete submissions.** All homework packets must be stapled or clipped, neat and legible (handwritten is fine if clear), and on standard size paper (no hanging "chads" from spiral notebooks) to be considered for grading. If the text used this semester is rather sparse when it comes to homework problems, I may post additional problems to supplement text questions. I will let you know. The Seeds text has been updated and will work fine, so additional problems are not required at this point. However, internet assignments **are considered as part of the homework and MUST be completed.**

Rules for homework:

- a. Must be neat and legible, typed or handwritten. Sloppy work that cannot be read will not be graded.
 - b. Must be stapled or clipped together, with work in sequence.
 - c. If you are unable to do a question, please indicate so.
 - d. **Some of the question must be contained in the answer** so that it makes grammatical sense and I know what you are talking about. It is not necessary to repeat questions unless you wish to.
 - e. Only college-quality work will be accepted for credit.
4. The **lowest score will be dropped, including the final.** However, there are **NO make-ups** and therefore *a missed exam is simply dropped* as the lowest score if you have missed an exam. Thus, the highest three letter grades determine the final grade. These may consist of three exams or two exams and a project. You **MUST** have at least two passing grades, however. Attendance credit will **NOT** raise an F to a D. If you do not understand this policy or disagree with it now, please speak up before we get underway and do not try and challenge it for any reason at a later date. I simply cannot make exceptions once policy is set- we all play by the same rules.

5. Grading will be performed as shown below. Once you receive a letter grade for an exam, that is all that counts-only the top three LETTER grades are averaged to arrive at a course grade. The following grade scale has been determined statistically to be valid over the past several years. Total points for each section exam (quizzes plus up to ten points for homework) yield the following letter grades:

50-59 = D

60-69 = C

70-79 = B

80-100 and over = A

Less than 50 = F

6. I often give **quizzes** in class. Sometimes I try to see if students are reading ahead or have followed up on material covered in the previous lecture. Be prepared for these! Go over the material covered in lecture the

same night while it is fresh in your mind. Each quiz counts 10-15 points, and these points are added to your raw score for the **following exam**. This a student may achieve a score of 50 on the exam, but with bonus points for quizzes (these are a form of extra credit) and homework, might end up with a much higher letter grade; even an A is possible. Students have indicated on evaluations in the past that they find my grading system to be exceedingly fair and that it gives them an opportunity to “show what they know” not only based on multiple-choice questions.

Any special testing needs must be arranged for prior to exams through the ASPIRE (OSD= Office for Student Disabilities) office. This can include in-class needs. You must pick up the exam in class in an envelope, take it to ASPIRE, and return it to me IMMEDIATELY upon completion for machine grading. If you think you are eligible for this service, please contact OSD for details. Anyone who has received extra time for exams, needs a reader, notetaker, etc., is highly encouraged to do this. I do not allow extra time in class and have found this service to be of great help for the students who qualify.

6. **Optional** Semester project –minimum 6-pages (single spaced, font 12 or smaller), based on library research or observational work equivalent to 1/3 semester of study (30+ hours). This may be used as a substitute for one exam. Topics must be submitted **by or before Week 8** for consideration and projects **completed no later than Week 12**. Do not even consider starting one at the end of the semester-you do not have time and will jeopardize your other grades. See section relating to sample topics if you think you are interested.

7. Our planetarium is now gone and the new one was deleted from the new Science Center due to budgetary constraints. I will try to make available viewing sessions in conjunction with Keene Amateur Astronomers. Attendance is not mandatory, but stargazing is a lot of fun. Attending does not earn credit either, but to truly experience the joy of astronomy, one really should look at the sky through a telescope! We usually try to view planets, galaxies, nebulae, clusters, the moon, etc. in addition to a general overview of the sky.

8. Exam format will be machine-graded multiple-choice and T/F. Please remember to **bring a #2 pencil to exams**. Scantron forms will be supplied, but **not pencils**.

10. Attendance in class maybe used to earn credit. If you have no more than three unexcused absences, you may petition, by way of **contract** to have your grade raised by one-half grade. Missed quizzes are used as a check, so if you don't know the answer, pass in a sheet with your name and simply say “don't know”. The rules of academic honesty apply and a grade of F will be assigned to anyone found abusing the attendance policy.

11. I usually post **Exam Keys** (*retain your exams* and use these to determine the correct answers to study for the comprehensive final) in a glass case or, if lacking one, at the library on reserve.

ETIQUETTE:

- Arrive for class on time. If you are late, use rear entrance if there is one. Do not walk in front of me.
- **Do not disturb professor** as he busily prepares and sets up for class! This is MY time; please respect it. Time is limited, and it belongs to everyone in the room. Personal questions will be answered **after** class and during office hours and general questions of interest to all (please **not ones clearly answered in the syllabus**, such as “Do you drop the lowest score?” Etc.) may always be asked at the start of lecture. If it is a “syllabus” question, I will usually respond with “Please refer to the syllabus”. I am **not being rude** (some seem to think

I am if I ignore them while setting up or give the answer above, according to some past evaluations, but we must have some form of order if I am to manage a large class and teach effectively). The syllabus should be complete and clear. I also have office hours-I know before class may be the most convenient for some, but I need to keep my thoughts and “game plan” in order and pt the class as a whole first. I always have some time for personal questions after lecture.

- **No talking** at any time. If you do so or create a distraction for the students or professor (this also includes reading books for other courses, newspapers, passing notes, etc.), *you may be asked to excuse yourself* and suffer a reduction in grade of one letter grade on the following exam. Be considerate of others. This is a very important issue-students sometimes complain about classmates to me or on evaluations and this is not excusable in college.
- Stay **awake**. If you cannot, please excuse yourself and nap at home.
- No reading other books or notes or typing on a laptop during lecture. This distracts me as well as classmates. It certainly won't help your grade! I promise to try not to be boring!!
- If you need to leave early or are ill, please sit in an end-of-aisle seat so you can get up discreetly and leave by the rear door.
- If you have a problem with reading my writing and overheads (my writing is not very clear due to a shoulder disability and our overhead projector may not be the most suitable for the room), please move to a seat **closer to the screen** and **let me know of any difficulty** immediately-thanks. If you cannot hear me, please let me know of that as well, and join us in the front. If you do opt to sit in the back, please **do not complain** about trouble with hearing, seeing, thermal discomfort, lack of eye contact, or recognition! If I find it necessary and space is available, I will declare back rows off-limits except during exams. I would like students to leave as much space between themselves as possible **on exam day**.
- No rustling papers in preparation for leaving before I finish speaking! If there is still no clock in the lecture hall, my clock will be considered official time. I set my watch by NPR and always a few minutes fast. I will be careful not to run overtime if at all possible. I may arrive for or start class a bit late if I have a lot to bring to class and set up. In general, I usually give the students time to “blow off steam” and relax at the start of the hour- at least five minutes. Take advantage of that time to talk to friends, even though I am in the room. When I gesture or ask that we start, **all noise ceases**.
- **Keep and know your syllabus**-it contains instructions regarding grading and policy and if I am asked a question about such matters at a later date, I will ask you to refer to it. Be sure you understand it from the start and feel free to ask any questions you wish about the contents during the first TWO classes. This is not to be interpreted as rudeness or disrespect, but I do not wish to use up class time answering questions to which answers are readily available. I will try and keep a current copy of the syllabus and rules on the website, as well. You are advised to keep your copy in your notebook. It is a contract between us and is sufficiently detailed to answer all of your questions about course procedure.
- **On Exam Day**, please leave as much space between you and your nearest neighbor as possible. **Do not sit in clusters-spread out**. Multiple versions of exams will usually be used and you must make sure that yours is placed in the appropriate location so that it is graded with the proper key!
- Astronomy, like other science gen. Ed. Courses, may be difficult for some of you. It will require effort to master. Please remember the **college-wide rule**: 2-3 hours/wk. of work outside of class for each credit. That **translates to 6-9 hrs/wk** for this course. If you have taken other intro or gen ed courses in which you have

not been challenged similarly, that is a shame. I WILL challenge you, including your ability to **think critically** and independently and, to some extent, do **quantitative work** (also Gen Ed requirements). Not all courses require this amount, but the assigned reading (PLEASE SKIM BEFORE CLASS) and homework, along with reviewing for exams, will probably translate to the above estimate. I will bear in mind at all times that you are not science majors and introduce all physical concepts accordingly, but *outside work is a must for full comprehension*. It is always best to **“skim” the chapter** (at least read the terms in the summary) **BEFORE** I cover it. Otherwise, you may have difficulty with the vocabulary and new terminology used in lecture. **I cannot overemphasize the importance of this!** Your comprehension will be enhanced manyfold! I am reminded of the student who said on his evaluation “Prof. Harkay might as well have been speaking in Arabic”. The same student also indicated that he had no textbook and, thus, had never read anything. It is crucial that you at least read the new vocabulary words in an end-of-chapter summary (also in boldface in the chapter) **BEFORE** I use them. You will encounter about 200 new vocabulary words. My explanation will be clearer if you have already seen them. I know its nice to sit back and be surprised in lecture, but comprehension suffers.

- The above rules are really just common courtesy and should be followed in all classes. **Not observing them is not only a sign of disrespect for your Professor, but for your colleagues as well.**

PREREQUISITES:

Minimal Math Competency (High School algebra, scientific notation, simple geometry). A math review is provided in the text. If you still do not feel at ease with the math, please take advantage of the math center facility. Aileen Phillips runs an excellent remedial program and you will be up to speed in no time. My personal view is that nobody should graduate from college without certain required math skills. This viewpoint is supported by the campus and administration as a whole. Good study habits and class participation are of paramount importance.

Class participation is highly encouraged as a facet of good organizational and study habits. I will frequently ask for classroom participation. **Preparation** by reading ahead and/or using reasoning skills will help you to participate fully in the educational process. Don't be intimidated because you are in a large room—simply speak up! The lectures will be *highly personalized* (text is not regurgitated) and exams are based almost entirely on material discussed in or alluded to in lecture. You are not responsible (on test) for material covered at outdoor viewing sessions. The study guide (if I make one available) and assigned questions and problems are intended to give you an idea of which topics are most highly stressed and may be candidates for exam material on some occasions.

I hope you find this course stimulating, thought provoking and informative. Good luck!

A personal comment:

Astronomy is a branch of physics and astronomers are all physicists. The astronomy students therefore should not be surprised to find that he/she is being exposed to and asked to learn about what may be perceived as “physics” topics in this course. My Doctoral degree is one with a specialty in physics, and I make no attempt to apologize or play down the extreme importance of basic physical principles in attempting to describe the workings of the Cosmos. The emphasis of such fundamentals also precedes a basis for offering this course as one satisfactory science prerequisite. I hope you share this enthusiasm and find this approach as fascinating as I do. If you have an intense dislike of “hardcore” science,” this may not be the course for you.

What is the role of astronomy in your undergraduate career? Are you taking it as a general education's elective? I hope you are doing so because you are genuinely inquisitive, the most noble reason of all. However, this course fulfills a vital role in your educational experience in addition to providing you with facts. The coming year will see tremendous advances in science and technology, which would confuse anyone who does not know how science progresses from data to hypothesis to natural law. Should your state permit nuclear waste disposal sites? Should you support construction of solar power stations? Is nuclear fusion a sage source of energy? To resolve technical issues, you need to apply some of the methods of science. As we study astronomy look at it as an example of scientific theory. Additionally, astronomy possesses great cultural value and tells us about our place in nature. You will see how the universe has developed and evolved, where the elements come from how planets and stars form and the emergence of life. This knowledge does not have monetary values, but it is priceless in that you will appreciate your experiences as a human being. You will see humanity as a unique part of a complex and beautiful universe. If, by the end of the course, you do not think of yourself and society differently; if you don't feel excited, and challenged and your imagination stretched, then you haven't been paying attention.

Suggested Term Paper Topics (Semester project)- *for those opting to do one*

Archeoastronomy
American Indian Astronomy
Central/South American Indian Astronomy
Babylonian Astronomy
Comparative Cosmologies and Origin of the Universe – Judeo/Christian, Norse, Hindu, Buddhist, Greek
Biography – Galileo and His Role in the Copernican Revolution
Biography- Johannes Kepler and the Evolution of His Views; His Laws
Biography – Einstein and His Impact upon Astronomy
Henrietta Leavitt and Variable Stars
The Politics of the Harvard Observatory from 1900 – 1940
The “Women of Harvard” – Annie Cannon and Colleagues
Book Review: Stephen Hawking – “A Brief History of Time”
The Big Bang
Book Review: Stephen Weinberg – “The First Three Minutes”
Book Review: Bigel Calder – Key to the Universe
The Probability of Finding Life Elsewhere
Unmanned Space Probes from the 1970s – Present
The Evolution of Optical Telescopes through Adaptive Optics
The Collision of Comet Shoemaker-Levy with Jupiter and What We Learned
The Search of Life on Mars
Colonization of Space – a Possibility?
A Critical Review of “2002” and “2010” from An Astronomical View Point
A Short Sci-Fi Story in the Style of Arthur C. Clarke
An Astronomical/Physical Critique of Science Fiction in the Movies
An Astronomical/Physical Critique of Science Fiction on TV
What H.G. Wells Did/Didn’t Know about Astronomy
Dark Matter – What is it and How is it Observed?
Book Review – Kaufmann: “Black Holes and Warped Space-time?”
the Solar-Terrestrial Connection: How Does the Sun Affect the Earth’s Atmosphere and Climate?
Supernova 1987A – It’s History, Observation, and Impact on Theories
The Science, Technology, and Politics of the “Space Race” from Sputnik-Apollo
The Economics of Space Exploration
What We Learned from the Apollo Missions
Biography – Vera Rubin
Computer Project (DOS) – An H-R Diagram for a Globular Cluster Using Observational Data
The History of Radio Astronomy through Interferometry
A Planet Capable of Supporting Life – What Are the “Specifications” and Probability of Finding Another One?
Biography – Harlow Shapely
The Role of the Hubble Constant in Cosmology, How it is Determined and Constraints of H and Dh/Dt
Quasars – Their Discovery, Properties, and Role in Cosmology
Gravitation Lens Studies
The Role of Inflation in Big Band Models
Experimental Evidence of Black Holes
The Search for Life on Mars
A Profile of An Astronomer (You May Interview any Living Astronomer Actively Involved in Research)
Astronomy in Art – A Historical Perspective
Astrology and Its Relation to Astronomy – Pro & Con
Comets – Theory and Observation through the Probes to Halley
Theories of Terrestrial Evolution Based on Astronomical Catastrophism
A Critical Review – Immanuel Velikovsky – “Worlds in Collision”

Minimum requirement for a semester project:

- Work equivalent to 1/3 semester of study for a 3-credit course, of one credit (about 30-40 hours).

- Paper shall be typed (word-processed), at least 6 pages, single-spaced, font size 12 or smaller.
- Several references shall be indicated in text using proper style. all quotes must be footnoted. No Plagiarism!
- There shall be several references in the case of a topical paper, and most shall be current (no old stuff – modern astronomy changes fast!)
- Paper is due next to last week of class. Topic must be submitted no later than week 8 of classes.
- Any student submitting paper which is not original, and used only in this course or one prepared by an outside agent of any sort shall automatically be assigned a grade of F for the course