Astronomy 1050: Survey of Astronomy

Fall 2008 Syllabus

Section 1 (Lecture)
Meeting Times: 12-12:50PM MWF — **Location:** Classroom Bldg. 129

Instructor: Dr. Rajib Ganguly
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FAX: (307) 766-2652 — **WWW:** http://physics.uwyo.edu/∼ganguly
Office Hours: TBD or by appointment

Sections 10,12,15,16 (Lab)
Meeting Times: §10: 3:10-5PM M — §12: 1:10-3PM T — §15: 1:10-3PM R — §16: 3:10-5PM R
Location: Physical Sciences 132
Teaching Assistant: Dan Lyons
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FAX: — **WWW:**
Office Hours: TBD or by appointment

Sections 11,13,14,17 (Lab)
Meeting Times: §11: 8:10-10AM T — §13: 3:10-5PM W — §14: 8:10-10AM R — §17: 7:10-9PM R
Location: Physical Sciences 132
Teaching Assistant: Mark Reiser
Office: Physical Sciences 107 — **Email:** reiser@uwyo.edu — **Phone:** (307) 399-3387
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Office Hours: TBD or by appointment

Supplemental Instruction through LeaRN
Meeting Times: 12-12:50PM T
Location: Physical Sciences 132
Supplemental Instructor: Jacquelyn Wolfgang
Email: jwolfgan@uwyo.edu

Course Description:

ASTRO 1050 is an introductory course for non-science majors. It provides a broad introduction to Astronomy including: (1) daily, monthly and yearly patterns in the sky; (2) basic physics of gravity, light, and atoms; (3) formation of the solar system; (4) stars and stellar evolution; (5) galaxies, cosmology, and the evolution of the Universe; and (6) the fundamental tenets of science and the scientific process. The goal of this course is to cover most of the areas of modern astronomy at a level which requires only basic mathematics.

Resources:

Required:

Astronomy Notes (**AN**) by Nick Strobel (http://www.astronomynotes.com)
– Online textbook for pedagogical development of concepts

Various Wikipedia Articles (**WA**)
– Supplemental reading for additional declarative knowledge (specific pages to be determined by instructors – see **Tentative Schedule** section)

Lecture Tutorials for Introductory Astronomy (**LT**) by Ed Prather, Tim Slater, Jeff Adams, Gina Brissenden, & the CAPER team
– Workbook for in-class exercises MUST BE PURCHASED NEW

Loose-leaf paper – for in-class assignments

Lab notebook

Optional:

Any astronomy textbook (e.g., *Horizons* by Michael Seeds, *The Cosmic Perspective* by Bennet et al., *Discovering Astronomy* by Steve Shawl)

Course Objectives:

We will follow the guidelines set forth by the American Astronomical Society, the National Science Education Standards, the American Association for the Advancement of Science, and the in-class survey. The goals for this class are as follows:

- Appreciate the scientific process, how it works, the notion that physical laws are universal, the elements of scientific theories, what they do and do not tell us.
- Develop familiarity with the night sky and how its appearance changes with time and position on Earth.
- Describe how data is collected from astronomical objects, and what quantities can be measured/inferred.
- Understand basic - yet crucial - physical laws, and the processes that govern astronomical quantities.
- Integrate concepts from related subjects to explain relationships (e.g., physics and math) between astronomical quantities.
- Infer the nature, structure and evolution of the Universe, and objects therein.

Instructional Philosophy of the Course:

The overarching goals of this course are for you to understand the nature of science through the eyes of astronomy; to understand the big ideas in astronomy; and to develop a lifelong interest in astronomy and current events surrounding astronomy. To meet these three goals, the course instructors have carefully designed a sequence of learning tasks and assessment procedures as outlined below.

-*Active engagement with nearly daily group activities.* It is a demonstrated fact that you can only learn a limited amount of information from lecture alone, no matter how clear or entertaining. Therefore, this course is composed of a series of mini-lectures that will be augmented by collaborative classroom activities called Lecture Tutorials (LT). The LT activities target specific ideas presented in lecture and are designed to be completed in groups of 3–4 people during class by talking through the questions and writing a detailed, consensus response. You will not submit these for grading. However, the questions are quite similar to the questions you will find on the course exams and you are therefore strongly encouraged to consider these activities as a critical component to your success in the course. The LTs are available at the bookstore and they must be brought to class each day. In order to nurture a collaborative and productive environment, we insist that cell phones, PDAs, blackberrys, etc. be turned off during the class. Communication with the outside world during class will be considered disruptive and disrespectful to the rest of the students (and could also be considered cheating – see **Academic Honesty**). Anyone caught using any of these devices during class will be asked to leave and a penalty may be assessed.

–*Attendance at all classes is REQUIRED.* Because this course is built around daily activities to accompany the lecture, your attendance and full participation at each class period will be an essential component of your success in the course. Periodically we will administer unscheduled questionnaires in class that will be collected during class and used to establish a participation grade. These questionnaires will not be given a letter or numeric grade, rather you will be given credit for what you complete on an all or nothing basis.

-*Carefully studying the text is REQUIRED.* The course mini-lectures are designed to focus on the really difficult aspects of astronomy or to provide structure for your out-of-class study. You are accountable for all material, concepts, and interrelationships presented in the mini-lectures, the text, and, most importantly, the Lecture Tutorials. Therefore, it is imperative to your success in this course that you complete the assigned readings prior to coming to class. Reading assignments should be completed BEFORE the date listed. Otherwise, the mini-lectures and tutorials will be less useful in helping you develop a deep understanding of the course topics. It is important to remember that the exams or questionnaires will cover material from the text readings that may or may not be discussed in class.

Assessment and Grading:

In order to promote an active and collaborative learning environment, there will be no curve to assess grades. Each student will only be competing against themselves, and will be responsible for gaining the declarative knowledge and conceptual understanding for performance. This is a four credit class with three credits in the primary lecture section (§1) and one credit from the accompanying lab section (§§10–17). Consequently, 75% of grade will arise from work done for the lecture section, and 25% from work in the lab section.

The portion of the grade in the lecture section will come from three sources: (1) midterm exams, (2) the final exam, and (3) attendance and class participation. Midterm exams will account for 30% of the final grade. There will be three midterm exams. The top two will count toward the grade (15% each) and **the lowest score will be dropped.** There will be no make ups for the midterm exams. The final exam is scheduled for December 12th from 10:15AM-12:15PM. It is **mandatory** and will be **comprehensive**. The final exam will contribute 30% of the final grade. All of the exams (midterms and final) will be multiple choice, and will be 100 points each (weighted according to how much they contribute to the final grade).

The exams will test your understanding of key concepts in astronomy. A list of these concepts can be found on pages 5–6 of this syllabus. We will use the performance on these exams in comparison with the Astronomy Survey conducted on the first day of class to measure the gain in knowledge and scientific understanding. In turn, this will help us in future semester to refine our teaching methods. Along with each exam, we will also ask for opinions regarding what you like, dislike, and ask for suggestions for improving the class.

The final portion of the grade from the lecture section will come from attendance and class participation. As mentioned above in the **Instructional Philosophy of the Course** section, we will periodically ask you to write a short paragraph on loose-leaf paper in class on a topic of our choosing. The topic may be related to the assigned reading, to a current event in astronomy, or to a key concept covered in that class period. These will be collected and perused by the instructors. Answers demonstrating a command of the assigned reading or concepts will be given full credit. No numerical or letter grade will be assigned to these questionnaires. These will be used to gauge both attendance and class participation, and will contribute to 15% of the final grade for the class.

The lab portion of the grade (25%) will come from a combination of a semester-long observing project and 12 labs to be done during the weekly two-hour lab sections. The instructor for the labs (the TA found on the front page of this syllabus) will grade the observing project and labs. The semester observing project and data/notes for the labs are to be meticulously kept in a lab notebook. (See below for details regard the semester observing project.) Lab reports are to be turned in within one of week of the lab session. Each lab will be assigned a maximum of seven points, and the semester observing project will be assigned a maximum of 14 points. The total of $(7 \times 12) + 14 = 98$ points are available. An additional two points will be awarded for turning in all lab reports in a timely manner and satisfying all requirements of the semester observing project,

for a total of 100 points.

The final grade will be computed using the scores from the top two midterm exams, the final exam, participation, and the lab in the following manner:

$$\begin{aligned}\text{Total points} \;=\; & 0.3 \times (\text{Final Exam}) \\ & +0.15 \times (\text{Midterm Total}) \\ & +0.15 \times 100 \times \left(\frac{\#\text{ quizzes}}{\text{total }\#\text{ quizzes}}\right) \\ & +0.25 \times (\text{Lab points})\end{aligned}$$

Grading Scheme

Total Points	Grade
85–100	A
75–84.999...	B
65–74.999...	C
50–64.999...	D
<50	F

From the total points, letter grades will be assigned according to the table on the right. There will be no plus or minus grades assigned.

Students with disabilities: If you require any special accommodations to participate in the class or complete assignments, please contact the instructor as soon as possible.

Academic Honesty:

University Regulation 803, Section 3 defines Academic Dishonesty:

"An act is academically dishonest when it is an act attempted or performed which misrepresents one's involvement in an academic task in any way, or permits another student to misrepresent the latter's involvement in an academic task by assisting in the misrepresentation. Some examples of academic dishonesty include such acts as: a. Representing as one's own work material copied or borrowed from any source, written or otherwise, public or private, without proper citation of the source. b. Using a ghost writer, commercial or otherwise, for any type of assignment. c. Submitting substantially the same work for more than one class without the explicit permission of all concerned instructors. d. Doing a class assignment for someone else or allowing someone to copy one's assignment. e. Using notes or prepared information in an examination unless authorized by the instructor. f. Taking an examination for someone else or allowing someone to take an examination for oneself. g. Copying from, or assisting, another student during an examination. h. Stealing, or otherwise improperly obtaining, copies of an examination before or after its administration. i. Submitting substantially the same work as someone else unless authorized by the instructor."

In addition, during the course of the semester, each student will be asked to carry out exercises in collaboration with other students. To nurture such an environment, we will consider any disruptive or disrespectful acts (such talking on a cell phone, or texting during class) to be a form of cheating. We consider academic dishonesty to be a serious offense and the maximum punishments allowed will be pursued in all scenarios. This includes completing any quizzes, or scantron forms with the help of another student or for scantron forms completed by another student who is not you. If similar work is submitted, all parties involved will receive a zero for their assignment. Make your work your own, be original.

Key Concepts for Astro 1050:

Ideas related to gravity:

- Gravity is the force that keeps planets in orbit around the Sun and governs the rest of the motion in the Solar System. Gravity alone holds us to the Earth's surface
- Gravitation is a universal force that each mass exerts on any other mass. The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

Ideas related to electromagnetic radiation:

- Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object–emitted by or scattered from it–must enter the eye.
- Electromagnetic waves result when a charged object is accelerated or decelerated. Electromagnetic waves include the electromagnetic spectrum from radio waves to gamma rays. The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength.
- Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts. These wavelengths can be used to identify the substance.

Ideas related to fusion:

- Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.
- Fusion is the joining of two nuclei at extremely high temperature and pressure, and is the process responsible for the energy of the sun and other stars.

The evolution of the universe

- The origin of the universe remains one of the greatest questions in science. The "big bang" theory places the origin between 10 and 20 billion years ago, when the universe began in a hot dense state; according to this theory, the universe has been expanding ever since.
- Early in the history of the universe, matter, primarily the light atoms hydrogen and helium, clumped together by gravitational attraction to form countless trillions of stars.

Stars and stellar evolution

- Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe.

The evolution and structure of the solar system

- The sun, the earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. The early earth was very different from the planet we live on today.
- The Earth is the third planet from the Sun in a system that includes the Moon, the Sun, other planets and their moons, and smaller objects, such as asteroids and comets. The Sun, an average star, is the central and largest body in the Solar System.

The Sun and Earth's seasons

- The Sun provides the light and heat necessary to maintain the temperature of the Earth.
- The Sun is the major source of energy for phenomena on the Earth's surface. Seasons result from variations in the amount of the Sun's energy hitting the surface due to the tilt of the Earth's rotation on its axis and the length of the day.

Yearly patterns, daily patterns and moon phases

- The Sun, Moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.
- Objects in the sky have patterns of movement. The Sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The Moon moves across the sky on a daily basis much like the Sun. The observable shape of the Moon changes from day to day in a cycle that lasts about a month.
- Most objects in the Solar System are in regular and predictable motion. Those motions explain such phenomena as the day, the year, the phases of the Moon, and eclipses.

Tentative Schedule of Topics, Assignments, and Exams

Date	Topic/Assignments
	Week 1 – Introductions
8/25	Introductions, Astronomy Survey, Popsicles, Office Hours, Tour of Universe
8/27	Discussion of Syllabus, Day-to-day class structure
8/29	Watch *Cosmic Voyage*: http://video.google.com/videoplay?docid=5757507304603419799
	AN: Math Review, Section 3 — http://www.astronomynotes.com/mathrev/s3.htm
	AN: Chapter 1, all sections — http://www.astronomynotes.com/chapter1/
	WA: http://en.wikipedia.org/wiki/Scientific_notation
	WA: http://en.wikipedia.org/wiki/Names_of_large_numbers
	LT: Sun size (105-107), Milky Way Scales (123-125)
	Week 2 – Patterns in the Sky
9/1	Labor Day – No Class
9/3	AN: Chapter 3, all sections EXCEPT Angles, Coordinates, Planetary Motions
	AN: – http://www.astronomynotes.com/nakedeye/chindex.htm
	WA: http://en.wikipedia.org/wiki/Celestial_sphere
	WA: http://en.wikipedia.org/wiki/Circumpolar_star
	LT: Position, Motion
9/5	LT: Seasonal Stars
	Week 3 – Patterns in the Sky
9/8	WA: http://en.wikipedia.org/wiki/Sidereal_day
	("Sidereal time and solar time" section only)
	LT: Solar vs. Sidereal Day, Ecliptic
9/10	WA: http://en.wikipedia.org/wiki/Moon_phases
	LT: The Cause of Moon Phases, Predicting Moon Phases
9/12	LT: Path of the Sun
	Week 4 – Seasons, Gravity
9/15	WA: http://en.wikipedia.org/wiki/Seasons
	LT: Seasons
9/17	AN: Chapter 4, section on Kepler's Laws of Planetary Motion
	AN: – http://www.astronomynotes.com/history/s7.htm#A5
	LT: Kepler's Second Law
9/19	LT: Kepler's Third Law

Date	Topic/Assignments
	Week 5 – Gravity, Midterm Exam
9/22	AN: Chapter 5, all sections – http://www.astronomynotes.com/gravappl/chindex.htm (AN: Chapter 6, all sections – http://www.astronomynotes.com/relativity/chindex.htm) LT: Newton's Laws and Gravity
9/24	Review Session
9/26	Midterm Exam 1 – Scales, Patterns in the Sky, Gravity
	Week 6 – Nature of Light
9/29	AN: Chapter 11, section 4 only – http://www.astronomynotes.com/starprop/s4.htm WA: http://en.wikipedia.org/wiki/Magnitude_(astronomy) WA: http://en.wikipedia.org/wiki/Apparent_magnitude WA: http://en.wikipedia.org/wiki/Absolute_magnitude (Introduction and prologue to WA: Stars and Galaxies sections only) LT: Apparent and Absolute Magnitudes of Stars
10/1	AN: Chapter 7, sections 1–3 – http://www.astronomynotes.com/light/chindex.htm LT: Electromagnetic Spectrum of Light
10/3	LT: Telescopes and Earth's Atmosphere
	Week 7 – Nature of Light
10/6	AN: Chapter 7, section 4 – http://www.astronomynotes.com/light/s4.htm LT: Blackbody Radiation
10/8	LT: Types of Spectra
10/10	AN: Chapter 7, sections 7–10 – http://www.astronomynotes.com/light/chindex.htm LT: Light and Atoms
	Week 8 – Nature of Light, Evolution and Structure of the Solar System
10/13	LT: Analyzing Spectra
10/15	LT: Doppler Shift
10/17	LT: Observing Retrograde Motion
	Week 9 – Evolution and Structure of the Solar System, Exam
10/20	Watch *"The Great Planet Debate"* between Niel DeGrasse Tyson and Mark Sykes, moderated by Ira Flato WA: http://en.wikipedia.org/wiki/Solar_system WA: http://en.wikipedia.org/wiki/Portal:Solar_System LT: Temperature and Formation of Our Solar System
10/22	Review Session

Date	Topic/Assignments
10/24	Midterm Exam 2 – Nature of Light, Solar System
	Week 10 – Stars
10/27	AN: Chapter 11, sections 1–11 – http://www.astronomynotes.com/starprop/chindex.htm
	LT: Luminosity, Temperature, and Size
10/29	AN: Chapter 11, sections 12–15 – http://www.astronomynotes.com/starprop/chindex.htm
	LT: H-R Diagram
10/31	AN: Chapter 12, all sections – http://www.astronomynotes.com/starsun/chindex.htm
	LT: Star Formation and Lifetimes
	Week 11 – Stellar Evolution, Evolution of the Universe
11/3	AN: Chapter 13, all sections – http://www.astronomynotes.com/evolutn/chindex.htm
	LT: Stellar Evolution
11/5	LT: Parallax and Distance
11/7	AN: Chapter 15, all sections – http://www.astronomynotes.com/galaxy/chindex.htm
	LT: Galaxy Classification
	Week 12 – Evolution of the Universe
11/10	AN: Chapter 16, all sections – http://www.astronomynotes.com/cosmolgy/chindex.htm
	LT: Looking at Distance Objects
11/12	LT: Expansion of he Universe
11/14	
	Week 13
11/17	
11/19	Review Session
11/21	Exam 3
	Week 14
	Thanksgiving Week – No Class, but Monday Lab will meet
	Week 15
12/1	
12/3	
12/5	
12/12	FINAL EXAM: 10:15AM-12:15PM

ASTRO 1050 – Survey of Astronomy
Student Information Sheet

Name: _____

Student ID Number: _____

Local Phone Number: _____

Email: _____

By signing below, I acknowledge I understand that:

(a) This course has scheduled examinations and a final examination as shown in the syllabus and listed in the University student schedule and that I will not make plans that interfere with these scheduled examinations. In addition, I will bring my photo-student ID to each examination and show to the test administrator if asked.

(b) Attendance is required for this course.

(c) In addition to assigning a course grade, the periodic questionnaires and scheduled exams are also used for purposes of improving this current course offering and future course offerings. Any and all scores gathered during this semester might be shared with other faculty or published, however, my name will never be associated with this data as a participant in any way.

_____ _____

Signature Date

ASTRO 1050 LAB # 1

SEMESTER OBSERVING PROJECT

I. Objective

Over the course of the semester, you will have the opportunity to observe many things, thereby imitating astronomers throughout history. Although contemporary astronomy is largely an indoor science, visual and telescopic observations are fundamental. Everything we know about the universe is either supported by observations or hinges on the support of future observations. Most of the observations you will make this semester will be similar to those that have been made by countless numbers of astronomers throughout history. However, they will be unique to you, and give you the opportunity to discover the nature of the universe for yourself.

Students often ask, "What is a good observation?" or "What should I draw?" Frustrated Astro 1050 instructors typically respond, "Draw what you see." The lesson is clear. An observation will depend on an observer's eyesight or other equipment used to make the observation, and one's ability to sketch in the dark. Even with this element of uncertainty, however, everyone's sketch of a Full Moon should be circular, the Andromeda Galaxy should not look like Jupiter, and the North Star should always be drawn roughly North. You should strive to record what you see as accurately as possible, but only in as much detail needed to clearly distinguish your object from another. You need not draw every star in Orion to obtain the general shape, for example.

One note: You will see in Lab #2 that the position and visibility of the stars depends greatly on when you are doing your observing. In order to be acceptable, every drawing MUST have the following information:

1. **The date,**
2. **The time,**
3. **The direction you are facing and the directions to your left and right**
4. **A label of what you have drawn.**

Without this information, you have only made a drawing, not an Observation that contains useful astronomical data!

II. Activities

The semester observing project will consist of three activities.

1. Naked eye observations of stars, constellations and planets
2. Telescopic observations using the telescopes on the roof of the Physical Sciences Building
3. Naked eye observations of the Moon and its phases

Each activity is described in more detail on the following pages, along with checklists to help you keep track of what you have and haven't done. All observations for all activities must be

meticulously recorded in your observing book (the lab notebook) with all the above information. At least once per month, your instructor must check over your work to make sure that (1) adequate progress on the project is being made, (2) that the observations are satisfactorily complete and of reasonable quality.

Good luck and enjoy your semester in Astro 1050!

Activity 1: Naked Eye Observations

All observations must be completed by semester's end. You only need to turn in one observation of each object, but you are encouraged to observe objects more than once until you feel that your sketch is a good one. Observations will be graded on completeness, accuracy, and clarity.

On the next page, there is a table of constellations and stars that you will need to observe for this part of the semester project. (Make sure you are looking under the correct semester.) Space has been left at the bottom as your instructor may suggest other objects, such as planets or comets, which are only visible at special times. Also note that the shapes of these constellations are subject to interpretation. The constellation of Ursa Major has been identified both as a large animal and a kitchen utensil. Which is it? Again, the best rule of thumb is to see for yourself. If you see a teapot instead of an archer when observing Sagittarius then remember it as a teapot. When lying on its side, Orion may look to you like a giant bow tie rather than a hunter; feel free to use your imagination.

Your sketches for Activity 1 will be semicircular sketches of the sky as shown in the sample sketch on the following page. The semi-circle is used to depict the half of the sky that you are facing. The horizon is depicted by the flat portion of the semi-circle. Objects seen directly overhead should be drawn at the top of the frame. The corners of the semi-circle are reserved for objects seen on the horizon directly to your left and right. Since the sky you observe depends on date, time, direction, and observing locale, you must record this information near all sketches. You may include as many stars, constellations, and planets in one sketch as you wish without making the sketch incomprehensibly congested. All objects MUST be clearly labeled. Furthermore, parts of the horizon may be obscured by buildings, trees, etc. These should be clearly and accurately depicted and labeled in your sketch.

Star charts to help you find constellations are available online, e.g., at http://www.heavens-above.com. A link with the proper information for observations from the University of Wyoming campus is available from the course web page. Please note that the projection of sky used in the star charts is not the same as the observations you will be making. In the star charts, the horizon is shown as the outside, circular border. They depict the entire sky, as if you are lying on your back. The observations that you will be recording require you to be standing, where you can only see half of the sky without contorting your body. The charts may be used as a guide to help you find the constellations. Observations that resemble star charts will be considered cheating.

Activity 1: Naked Eye Observations Checklist

Fall Semester		**Spring Semester**	
Ursa Major (Big Dipper)		Ursa Major (Big Dipper)	
Ursa Minor (Little Dipper) with *Polaris*		Ursa Minor (Little Dipper) with *Polaris*	
Auriga (the Charioteer) with *Capella*		Auriga (the Charioteer) with *Capella*	
Cepheus (the King)		Cepheus (the King)	
Cassiopeia (the Queen)		Cassiopeia (the Queen)	
Cygnus (the Swan) with *Deneb*		Cygnus (the Swan) with *Deneb*	
Boötes (the Herdsman) with *Arcturus*		Boötes (the Herdsman) with *Arcturus*	
Lyra (the Lyre) with *Vega*		Lyra (the Lyre) with *Vega*	
Pegasus (the Winged Horse) with *the Great Square*		Pegasus (the Winged Horse) with *the Great Square*	
Perseus (the Warrior)		Perseus (the Warrior)	
Taurus (the Bull) with *Aldebaran*		Taurus (the Bull) with *Aldebaran*	
Scorpius (the Scorpion) with *Antares*		Orion (the Hunter) with *Betelgeuse* and *Rigel*	
Sagittarius (the Archer)		The Pleiades (the Seven Sisters)	
Summer Triangle with *Deneb*, *Vega*, and *Altair*		Leo (the Lion) with *Regulus*	
Aquila (the Eagle) with *Altair*		Canis Major (the Big Dog) with *Sirius* (the brightest star in the night sky)	
Virgo (the Maiden) with *Spica*		Canis Minor (the Little Dog) with *Procyon*	
Hercules (the Strongman)		Gemini (the Twins) with *Castor* and *Pollux*	

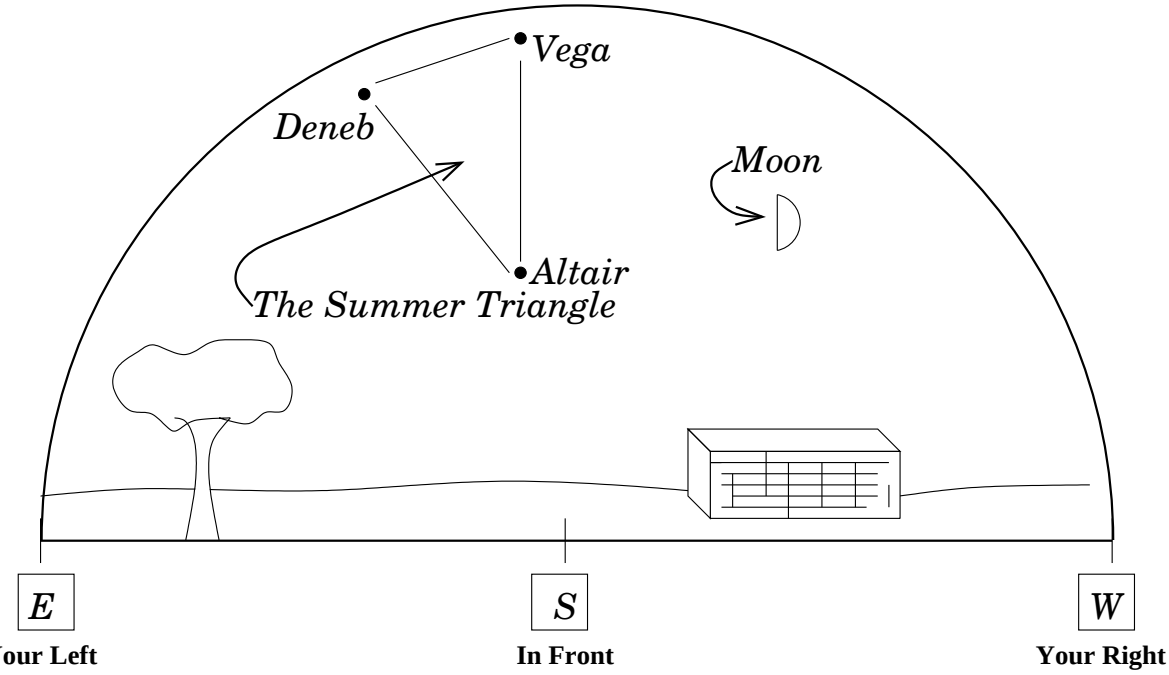
Sample Sketch for Activity 1

Naked Eye Sketch

Title: *Summer Triangle & Moon Phase* **Observing Site:** *Prexy's Pasture*

Date and Time: *Mon, Sept 24, 2001, 8:30pm* **Sky Condition:** *very clear!!*

Overhead



Description: *Drawing made from Prexy's Pasture. Sky was clear, but bright, only a few stars other than those in the summer triangle were visible. Moon was half full, with right side (west side) illuminated.*

Activity 2: Telescopic Observations Checklist

Fall Semester	**Spring Semester**
Mizar and Alcor in Ursa Major (double star)	Mizar and Alcor in Ursa Major (double star)
Albireo in Cygnus (double star)	The Orion Nebula
M13 in Hercules (a globular cluster)	The Pleiades (an open star cluster)
The Andromeda Galaxy (M31)	M15 in Pegasus (a globular cluster)

Activity 2: Telescopic Observations

Occasionally during the semester, the lab instructors will provide opportunities for observing the objects listed in the above table using the telescopes on the roof of the Physical Sciences Building. Again, space has been left intentionally blank for planets or other objects which may be visible at special times. A sample observation for Activity 2 is given below. Telescopic observations capture a very small portion of the sky, and thus should not be semicircular. Draw your observations within a circle that represents the edge of your field of view. The same rules for time, date, etc. apply.

Sample Sketch for Activity 2

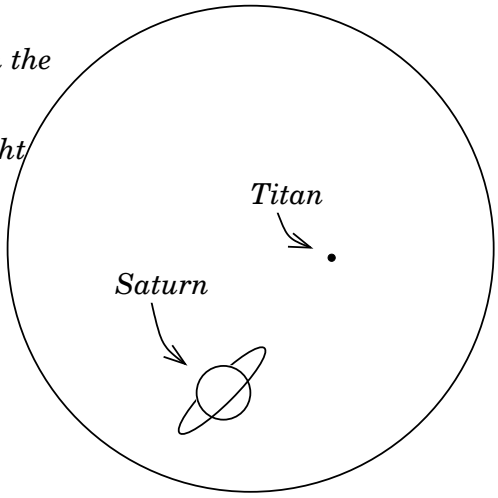
Telescope Sketch

Title: *Saturn & Titan* **Observing Site:** *Phys. Sci. Roof*

Date and Time: *Tues, Nov 27, 2001, 9:00pm* **Sky Condition:** *clear*

Description:

Looking through 8–inch telescope on the roof of Phys. Sci. Saturn was yellowish–grey. The rings were bright and visible. Titan looked just like a white dot, much like a star.



Activity 3: Naked Eye Observations of the Phase of the Earth's Moon

For this activity you will sketch the shape, appearance, and position in the sky of the Moon on different dates. Choose a two week time period over which to observe the Moon **at the same time every single day/night**. (Confer with your lab instructor for suggestions of appropriate times in a given two week period.) For each observation within this two-week time period, make a naked-eye observation in the same manner as in Activity 1, facing South with due West to your right and due East to your left. If desired, these can be combined with observations for Activity 1. The instructors appreciate that sometimes "life" can get in the way of a project that takes two weeks to carry out. Hence, to receive full credit for this activity, you must make at least ten observations in the two week period.

Each observation of the Moon must include:

1. Date and time of the observation
2. Description of observation
3. Sky conditions
4. Compass directions
5. Sketch of the moon's location in the sky (see example on page 4)
6. Sketch of the "shape" of the moon. If the moon is only partially illuminated, make a careful note of which side, left or right, is lit.

As the Moon orbits the Earth once every month, we see the side of it that is illuminated by the sun from different angles. That is what causes the Moon to appear to go through phases. Each phase corresponds to a different angle between us (Earth), the Moon, and the Sun. For example, Full is when the Earth sits between the Moon and the Sun; at that time, the illuminated half of the Moon is facing us. If the Moon, Earth, and Sun make a right angle, then we see only half of the side of the Moon illuminated by the Sun, and this is called first or third quarter phase (depending on which side of the Moon is lit).