

# ASTRO 1050 - Survey of Astronomy

## Syllabus: Summer 2009

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Lecture: M-F, 11:00 am - 12:20 pm  
LAB: TWR, 1:20 pm - 2:40 pm  
Hours: TWR, 12:20 pm - 1:20 pm

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### 1. Resources

#### Texts:

Universe w/ Starry Night Enthusiast CD-ROM  
Roger Freedman, William J. Kaufmann  
Edition: 8th  
ISBN: 0716795647

AND

Lecture Tutorials for Introductory Astronomy (2nd Edition) (Addison-Wesley Series in Educational Innovation)  
Edward E. Prather, Tim P. Slater, Jeff Adams, Gina Brissenden, CAPER  
Edition: 2  
ISBN: 0132392267

**Materials for class/lab:**

- One bound composition Lab/Observing notebook
- Loose leaf paper
- Writing utensils
- 3-ring notebook
- Flashcards
- Scientific Calculator

**Materials made available online:**

We will be using a course website on the WyoSakai system. Go to the OnLnSupp page, <http://www.uwo.edu/onlnsupp>, follow the Student Info link on the left, and read the appropriate section (WyoSakai) of the instructions.

WYOSAKAI - <http://wyosakai.uwo.edu/xsl-portal>

An open-access Companion Web site is available at the text's website (see below). It reinforces concepts and provides self-study review quizzes, Star Charts, conceptual animations, videos, and Interactive Exercises. You will need to sign up through the website to gain access to online quizzing which is required for the course.

UNIVERSE TEXT - <http://bcs.whfreeman.com/universe8e>

**Web:**

Here are some Websites that I love/have found useful:

American Astronomical Society - [www.aas.org/education/](http://www.aas.org/education/)

NASA - <http://www.nasa.gov/home/index.html>

Astronomy Pic of the Day (APOD) - <http://apod.nasa.gov/apod/>

COSMOS, The SAO Encyclopedia of Astronomy - <http://astronomy.swin.edu.au/cosmos/>

*Sky & Telescope*, Magazine - <http://skytonight.com/>

*Earth & Sky*, Radio - <http://www.earthsky.org>

## 2. Course Objectives & Philosophy

**Students:** College is a time of learning and growth. Here are some qualities of successful students:

- They attend class regularly and on time.
  - They do extra credit assignments when they are available.
  - Their assignments are done neatly.
  - If they feel they need extra help, they let their teacher know.
  - They turn in all assignments.
  - They pay attention in class and are courteous and polite.
  - They speak up in class.
  - They learn to identify what needs to be studied in greatest detail.
  - They set short-term and long-term goals.
  - They see their teachers before and after class.
  - They learn to schedule enough time for homework.
  - They enjoy being successful students.
  - If they do have to miss classes (they inform their teacher as to why), they find out what they missed and make sure they understand all that was covered.
  - They know they are responsible for their own success.
- Dr. James L. Warner

If you do not currently possess these qualities, it is highly encouraged that you do so by the end of this course.

**Science:** Guidelines from the American Astronomical Society, the National Science Education Standards, the American Association for Advancement of Science:

- 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.

**Astronomy:** This is a compilation of what ideals college students should learn in an introductory astronomy class:

**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 last 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.

**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 Sun's energy hitting the surface due to the tilt of the Earth's rotation on its axis and the length of the day.

### **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.

### **Electromagnetism:**

- 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 amount and thus can absorb and emit light only at wavelengths corresponding to these amounts. These wavelengths can be used to identify the substance.

### **Evolution and Structure of the Universe:**

- 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, eight 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.

### **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.

### 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.

### 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.

### 3. Assessment and Grading

Type	Number of	Percentage
Quizzes	~25	25%
Projects	2	25%
Labs	~15	25%
Exams	4	25%

**Note:** There will be no dropping of grades, makeups or curving of grades! However, there ‘might’ be extra credit. There will be one quiz per chapter. There are two projects; i) a Semester Observing Project, and, ii) a group Podcast Presentation. There are approximately 15 Labs whose topics are coincident with lecture. There are four exams, one for each unit of the text.

#### 4. Academic Honesty

The University of Wyoming has very strict regulations concerning academic dishonesty. In short, “academic dishonesty” involves cheating on an examination, a paper, or other class assignments. The penalties can be severe. Each student is expected to be aware of and to abide by the academic dishonesty policy, as specified in UW Regulation 6-802. Ignorance of what constitutes plagiarism, how to properly cite sources, or what is appropriate behavior on an examination or class assignment is not an acceptable defense against a charge of academic dishonesty. Students uncertain as to whether a particular act violates the University’s academic dishonesty policy should consult their instructor, the head of the department, their academic advisor, the Office of Student Life, or another appropriate University official.

UW Regulation 6-802 §4 defines academic dishonesty as “an act attempted or performed that misrepresents one’s involvement in an academic task in any way, or assists another student to misrepresent his or her involvement in an academic endeavor.” Among the misdeeds by students that the University of Wyoming considers acts of academic dishonesty are:

1. Plagiarism: presenting the work (i.e., ideas, data, creations) of another, wholly or in part, as one’s own work without customary and proper acknowledgement of sources and extent of use, unless authorized by the instructor.
2. Cheating: using information, study aids, notes, materials, devices, or collaboration not explicitly approved by the instructor. For example: doing a class assignment for someone else or allowing someone to copy one’s assignment; copying from, or assisting, another student during an examination; or stealing, or otherwise improperly obtaining, copies of an examination before or after its administration.
3. Fraud: altering or inventing data, research, or citations for an academic endeavor; fabricating, forging or otherwise misrepresenting to an instructor or an institution one’s past or current academic or professional activities; impersonating someone or allowing oneself to be impersonated for an examination or other academic endeavor; using a ghost writer, commercial or otherwise, for any type of assignment.
4. Violation of Standards: violations against ethical and professional standards required by individual University programs, academic courses, and clinical programs that may result in qualification for entry into a profession that maintains standards of conduct.
5. Multiple Submissions: submitting, wholly or in part, the same academic endeavor to earn credit in two or more courses without explicit approval by all concerned instructors.

6. Interference or Obstruction: interfering with academic efforts of other students to gain unfair advantage for personal academic advancement. Interference may include but is not limited to, sabotage, harassment, tampering, bribery, or intimidation of another student.
7. Complicity: assisting another person in any act of academic dishonesty as defined above.

## **5. Schedule of Topics, Assignments and Exams**

**Note:** Subject to change. Students will be responsible for in-class assigned assignments as well.



Table 1. Tentative Topics, Assignments and Exam Schedule

Week	Chapters	Lecture Tutorials	Reading & Quizzes	Labs	Unit Exam
<b>Unit I - Introducing Astronomy</b>					
1	I.1 Astronomy ... Universe I.2 Knowing the Heavens I.3 Eclipses ... Moon I.4 Gravitation ... Planets	All Night Sky, Path of the Sun, Seasons, Cause/Pred Moon Phases, Kepler's, Gravity, Retrograde	Ch 1-5 DUE: Tues (5/26), 11am	P.1 Podcast Presentation 1. Math Review 2. Planetarium	
2	I.5 The Nature of Light I.6 Optics and Telescopes	EM Spec, BB Rad, Spectra, Light,	Ch 6-9 DUE: Mon (6/1), 11am	3. Orbits (Kepler's) 4. EM Spectrum	I. Fri (5/29)
<b>Unit II - Planets and Moons</b>					
2	II.7 Comp. Planetology I II.8 Comp. Planetology II	Sun Size, Temp. and SS Form.		5. Tel. and Atm. (LT)	
3	II.9 The Living Earth II.10 Our Barren Moon II.11 Mercury, Venus, Mars II.12 Jupiter, Saturn II.13 J&S: Satellites	ES Planets, Earth's Surf.	Ch 10-14 DUE: Mon (6/8), 11 am	6. Scale: How Big? 7. Planetary Geology 8. Jupiter's Moons	
4	II.14 Uranus, Neptune, Pluto ...	ES Planets,	Ch 16,17,19,20,22		II. Wed-LAB (6/10)
<b>Unit III - Stars and Stellar Evolution</b>					
4	III.16 Our Star, the Sun III.17 The Nature of Stars III.19 Stellar Ev: Post-MS III.20 Stellar Ev: Star-Death	Parsec, Parallax, Magnitudes, H-R, Binary Stars, Star Lifetimes	DUE: Mon (6/15), 11 am	9. Parallax & Angular ... 10. HR Diagram (LT)	
5	III.22 Black Holes	Parsec, Parallax,	Ch 23-26,28	11. Seven Sisters ...	
<b>Unit IV - Galaxies and Cosmology</b>					
5	IV.23 Our Galaxy IV.24 Galaxies IV.25 QSOs, AGN, $\gamma$ -ray ... IV.26 Cosmology: Ev ...	Stellar Ev, MW Scales, Galaxy Class.	DUE: Mon (6/22), 11 am	12. Milky Way	III. Wed-LAB (6/17)
6	IV.28 Search for Extra-Ter ... P.4 Podcast Presentations P.4 Podcast Presentations P.4 Podcast Presentations	Exp. Universe		13. Galaxy Zoo 14. Exp. Universe 15. Search for Extra-Ter	IV. Fri (6/26)



## 6. Exam Study Guide Outline

**Note:** Students are responsible for **all** content in the chapters listed below. This includes, but is not limited to, i) each chapter section, ii) Boxes, iii) Cosmic Connections, iv) Guest Essays, v) assigned homework (online-Quizzes), vi) Lecture Tutorials and vii) Labs.

### I. Introducing Astronomy

1. Astronomy and the Universe
  - 1-1 Astronomy and the Scientific Method
  - 1-2 The Solar System
  - 1-3 Stars and Stellar Evolution
  - 1-4 Galaxies and Cosmology
  - 1-5 Angles and Angular Measure
  - 1-6 Powers of Ten
  - 1-7 Astronomical Distances
  - 1-8 The Adventure of Astronomy
2. Knowing the Heavens
  - 2-1 Ancient Astronomy
  - 2-2 Constellations
  - 2-3 Motions of the Sky
  - 2-4 The Celestial Sphere
  - 2-5 The Seasons
  - 2-6 Precession
  - 2-7 Time and Timekeeping
  - 2-8 The Calendar
3. Eclipses and the Motion of the Moon
  - 3-1 Phases of the Moon
  - 3-2 The Moon's Rotation
  - 3-3 Eclipses and the Line of Nodes
  - 3-4 Lunar Eclipses
  - 3-5 Solar Eclipses
  - 3-6 Measuring the Earth
4. Gravitation and the Waltz of the Planets

- 4-1 Geocentric Models
- 4-2 Copernicus and Heliocentric Models
- 4-3 Tycho Brahe's Observations
- 4-4 Kepler and the Orbits of the Planets
- 4-5 Galileo and the Telescope
- 4-6 Newton's Laws of Motion
- 4-7 Newton and Gravity
- 4-8 Tides and the Moon
- 5. The Nature of Light
  - 5-1 The Speed of Light
  - 5-2 The Wave Nature of Light
  - 5-3 Blackbody Radiation
  - 5-4 Wien's Law and the Stefan-Boltzmann Law
  - 5-5 The Particle Nature of Light
  - 5-6 Kirchhoff's Laws
  - 5-7 Atomic Structure
  - 5-8 Spectral Lines and the Bohr Model
  - 5-9 The Doppler Effect
- 6. Optics and Telescopes
  - 6-1 Refracting Telescopes
  - 6-2 Reflecting Telescopes
  - 6-3 Angular Resolution
  - 6-4 Charge-Coupled Devices (CCDs)
  - 6-5 Spectrographs
  - 6-6 Radio Telescopes
  - 6-7 Telescopes in Space

## II. Planets and Moons

- 7. Comparative Planetology I: Our Solar System
  - 7-1 Terrestrial and Jovian Planets
  - 7-2 Satellites of the Planets
  - 7-3 The Evidence of Spectroscopy
  - 7-4 Chemical Composition of the Planets

- 7-5 Asteroids, Trans-Neptunian Objects, and Comets
- 7-6 Cratering and Impacts
- 7-7 Magnetic Fields and the Interiors of Planets
- 7-8 Solar System Diversity
- 8. Comparative Planetology II: The Origin of Our Solar System
  - 8-1 Models of Solar System Diversity
  - 8-2 Abundances of the Elements
  - 8-3 The Age of the Solar System
  - 8-4 The Origin of the Solar System
  - 8-5 Forming the Terrestrial Planets
  - 8-6 Forming the Jovian Planets
  - 8-7 Extrasolar Planets
- 9. The Living Earth
  - 9-1 The Earth's Energy Sources
  - 9-2 Earthquakes and the Earth's Interior
  - 9-3 Plate Tectonics
  - 9-4 The Earth's Magnetic Field
  - 9-5 The Earth's Evolving Atmosphere
  - 9-6 Circulation in Earth's Atmosphere
  - 9-7 Human Influence on the Earth's Biosphere
- 10. Our Barren Moon - \*\* Group\*\*
  - 10-1 The Moon's Airless Surface
  - 10-2 Voyages to the Moon
  - 10-3 The Moon's Interior
  - 10-4 Moon Rocks
  - 10-5 The Formation of the Moon
- 11. Mercury, Venus, and Mars: Earthlike yet Unique
  - 11-1 Mercury, Venus, and Mars as Seen from Earth
  - 11-2 The Curious Rotation of Mercury and Venus
  - 11-3 Mercury's Surface and Interior
  - 11-4 Missions to Venus and Mars
  - 11-5 Volcanoes and Craters on Venus and Mars

- 11-6 The Atmospheres of Venus and Mars
- 11-7 Climate Evolution on Venus and Mars
- 11-8 Searching for Ancient Martian Water
- 11-9 The Moons of Mars
- 12. Jupiter and Saturn: Lords of the Planets
  - 12-1 Jupiter and Saturn as Seen from Earth
  - 12-2 Jupiter and Saturn's Rotation and Structure
  - 12-3 The Clouds of Jupiter and Saturn
  - 12-4 Atmospheric Motions on Jupiter and Saturn
  - 12-5 Probing Jupiter's Atmosphere
  - 12-6 The Rocky Cores of Jupiter and Saturn
  - 12-7 The Magnetic Fields of Jupiter and Saturn
  - 12-8 Discovering Saturn's Rings
  - 12-9 The Composition of Saturn's and Jupiter's Rings
  - 12-10 The Structure of Saturn's Rings
  - 12-11 Rings and Shepherd Satellites
- 13. Jupiter and Saturns Satellites of Fire and Ice - \*\* Group\*\*
  - 13-1 Jupiter's Galilean Satellites as Seen from Earth
  - 13-2 Sizes, Masses, and Densities of the Galilean Satellites
  - 13-3 Formation of the Galilean Satellites
  - 13-4 Io's Active Volcanoes
  - 13-5 Electric Currents in Io
  - 13-6 Europa's Icy Crust
  - 13-7 Cratered Ganymede and Callisto
  - 13-8 Exploring Titan's Hydrocarbon Atmosphere
  - 13-9 Jupiter's Swarm of Small Satellites
  - 13-10 Saturn's Other Icy Satellites
- 14. Uranus, Neptune, Pluto and the Kuiper Belt: Remote Worlds
  - 14-1 Discovering Uranus and Neptune
  - 14-2 Weather and Seasons on Uranus
  - 14-3 Cloud Patterns on Neptune
  - 14-4 Inside Uranus and Neptune

- 14-5 Magnetic Fields of Uranus and Neptune
- 14-6 The Rings of Uranus and Neptune
- 14-7 Uranus's Satellites
- 14-8 Neptune's Satellites
- 14-9 Pluto and its Satellites
- 14-10 Trans-Neptunian Objects
- 15. Vagabonds of the Solar System - \*\* Group\*\*
  - 15-1 The Discovery of the Asteroids
  - 15-2 Jupiter and the Asteroid Belt
  - 15-3 The Nature of Asteroids
  - 15-4 Impacts on Earth
  - 15-5 Classifying Meteorites
  - 15-6 Meteorites and Our Origins
  - 15-7 Comets
  - 15-8 Comet Origins and Meteor Showers

### III. Stars and Stellar Evolution

- 16. Our Star, the Sun - \*\* Group\*\*
  - 16-1 Thermonuclear Energy
  - 16-2 A Model of the Sun
  - 16-3 Solar Seismology
  - 16-4 Solar Neutrinos
  - 16-5 The Photosphere
  - 16-6 The Chromosphere
  - 16-7 The Corona
  - 16-8 Sunspots
  - 16-9 The Sunspot Cycle
  - 16-10 The Active Sun
- 17. The Nature of the Stars
  - 17-1 Stellar Distances and Parallax
  - 17-2 Apparent Brightness and Luminosity
  - 17-3 The Magnitude Scale
  - 17-4 Star Colors and Temperatures

- 17-5 Spectral Classes
- 17-6 The Sizes of Stars
- 17-7 The Hertzsprung-Russell Diagram
- 17-8 Spectroscopic Parallax
- 17-9 Binary Stars and Stellar Masses
- 17-10 Spectroscopy and Close Binaries
- 17-11 Eclipsing Binaries
- 18. The Birth of Stars - \*\* Group\*\*
  - 18-1 Modeling Stellar Evolution
  - 18-2 The Interstellar Medium
  - 18-3 Protostars and Dark Nebulae
  - 18-4 Reaching the Main Sequence
  - 18-5 Mass Ejection and Accretion
  - 18-6 Young Stars and H II Regions
  - 18-7 Giant Molecular Clouds
  - 18-8 Supernovae and Star Birth
- 19. Stellar Evolution: After the Main Sequence
  - 19-1 Evolution on the Main Sequence
  - 19-2 Red Giants
  - 19-3 Helium Fusion
  - 19-4 Star Clusters and Stellar Evolution
  - 19-5 Population I and II Stars
  - 19-6 Pulsating Stars
  - 19-7 Mass Transfer in Close Binaries
- 20. Stellar Evolution: the Deaths of Stars
  - 20-1 A Second Red-Giant Phase
  - 20-2 Dredge-up and carbon Stars
  - 20-3 Planetary Nebulae
  - 20-4 White Dwarfs
  - 20-5 The Creation of Heavy Elements
  - 20-6 Core-Collapse Supernovae
  - 20-7 Supernova 1987A



20-8 Detecting Supernova Neutrinos

20-9 White Dwarfs and Supernovae

20-10 Supernova Remnants

21. Neutron Stars - \*\* Group\*\*

21-1 Neutrons and Neutron Stars

21-2 Pulsars

21-3 Modeling Pulsars

21-4 Pulsar Slowing and Energy Loss

21-5 Inside a Neutron Star

21-6 Magnetars

21-7 Millisecond Pulsars

21-8 Pulsating X-ray Sources

21-9 Novae and X-ray Bursters

21-10 Beyond Neutron Stars

22. Black Holes

22-1 The Special Theory of Relativity

22-2 The General Theory of Relativity

22-3 Black Holes in Binary Systems

22-4 Gamma-ray Bursters

22-5 Supermassive Black Holes

22-6 The Event Horizon

22-7 Mass, Charge, and Spin

22-8 Falling into a Black Hole

22-9 Evaporating Black Holes

IV. Galaxies and Cosmology

23. Our Galaxy

23-1 Our Place in the Galaxy

23-2 The Galaxy's Shape and Size

23-3 Spiral Arms

23-4 The Sun's Orbit and Dark Matter

23-5 Density Waves

23-6 At the Center of the Galaxy

24. Galaxies

- 24-1 Island Universe
- 24-2 The Distances to Galaxies
- 24-3 Classifying Galaxies
- 24-4 The Distance Ladder
- 24-5 The Hubble Law
- 24-6 Clusters and Superclusters
- 24-7 Colliding Galaxies
- 24-8 Dark Matter in the Universe
- 24-9 The Evolution of Galaxies

25. Quasars, Active Galaxies, and Gamma-Ray Bursters

- 25-1 The Discovery of Quasars
- 25-2 Ultraluminous Galactic Nuclei
- 25-3 Seyfert and Radio Galaxies
- 25-4 Active Galactic Nuclei
- 25-5 Black Holes as "Central Engines"
- 25-6 A Unified Model

26. Cosmology: The Origin and Evolution of the Universe

- 26-1 The Dark Night Sky
- 26-2 The Expanding Universe
- 26-3 The Big Bang
- 26-4 The Cosmic Microwave Background
- 26-5 The Universe Before Recombination
- 26-6 The Shape of the Universe
- 26-7 Dark Energy and the Accelerating Universe
- 26-8 Primordial Sound Waves

27. Exploring the Early Universe - \*\* Group (HARD) \*\*

- 27-1 Cosmic Inflation
- 27-2 The Fundamental Forces and Symmetry Breaking
- 27-3 Matter, Antimatter, and the Uncertainty Principle
- 27-4 Matter-Antimatter Annihilation
- 27-5 Relics of the Primordial Fireball

- 27-6 The First Stars and Galaxies
- 27-7 The Dimensions of Spacetime
- 28. The Search for Extraterrestrial Life - \*\* Group\*\*
  - 28-1 Building Blocks of Life
  - 28-2 Life in the Solar System
  - 28-3 Meteorites from Mars
  - 28-4 The Drake Equation
  - 28-5 Radio Searches for Civilizations
  - 28-6 Infrared Searches for Planets