AST 111: Tu-Thu 10:30am - 11:45am STUDY GUIDE FOR EXAM 2

1. YOU MUST NOT USE YOUR LAPTOP OR YOUR CELLPHONE
(ReRead the Header information given on Study Guide 1)

6. **Chapter 5. Newton, Galileo, and Gravity (SKIP Section 5-3)**
a. When was Newton born?
b. Know about Galileo and the experiments that he performed. He learned that falling bodies are accelerated, that the amount of acceleration did not depend on the mass of the object, and that motion was as natural as standing still.
c. Know Newton's 3 laws of motion. What is momentum? Why is velocity not the same thing as speed? What is acceleration?
d. What does F=ma mean? What happens if we apply the same amount of force to objects with different masses? Be familiar with Table 5-1
e. Know the Law of Gravity. What is an inverse square law? How is skateboarding explained by Newton's third law? What about a rocket launch?
f. Why do we talk about an orbiting space craft as being in Free Fall? (Page 86-87)
g. What is the circular velocity of an object in orbit? Remember that "r" is the distance from the center of the earth, sun, etc to the satellite.
h. What is the distance from the center of the Earth to an object in Geosynchronous orbit? Why do we care about Geosynchronous orbits? (Pages 86-87)
i. The different kinds of orbits in an inverse-square-law force are ellipse, circle, parabola, hyperbola, straight line. Some are closed and some are open. (Know what is meant by an open and closed orbit)
j. The escape speed is that speed that allows a space craft to just escape from a planet. That does not mean that it has escaped from the gravity of the planet. Just that, if it is traveling at that speed or faster, it will never fall back to the planet.
k. Read how Newton re-discussed Kepler's laws and "explained" them. What does Kepler's Third law look like after Newton worked on it. How can we use it to determine the mass of the Sun, of Jupiter, the Earth, binary stars (discussed in class)?
l. Read about the tides. Why is there a tide on the opposite side of the Earth from the Moon?
m. What are spring tides and neap tides?
n. SKIP 5-3
o. Try to do problems 1 and 3 on page 99. Review all the problems that I have handed out.

Chapter 6: Light and Telescopes
a. What is meant by electromagnetic radiation? What are some of the properties of light?
b. What is meant by the wavelength and frequency of light?
c. What is an Angstrom? I use Angstroms in class not nanometers. What is the velocity of light in cm/sec?
d. What is a photon? What is meant by the wave-particle duality of light?
e. What is the relationship between wavelength, frequency, and energy of light? How does the energy of a photon of light depend on its wavelength? What kind of light is most energetic, least energetic?
f. What are the various parts of the spectrum? Know the different kinds of light (page 103:Figure 6-3.) such as: infra-red, ultraviolet, X-ray, Gamma-ray
g. What is meant by atmospheric windows? Where in the spectrum is the atmosphere transparent, opaque (Figure 6-3; page 103)?
h. What are refracting telescopes? Reflecting telescopes? How do they differ?
i. What is meant by the primary lens or mirror of a telescope? Eyepiece?
j. What is the fundamental difficulty with refracting telescopes? (Chromatic Aberration)
k. How does a telescope form an image? Note that the image is upside down (Figure 6-5). How is your eye like a telescope?
l. What is meant by the focus of a lens or mirror? What is the focal length of a lens or mirror?
m. What is an achromatic lens? Does it really cure chromatic aberration or does it just use it?
n. What is a Newtonian telescope? Cassegrain telescope? Prime Focus? (Look at Pages 112-113)
o. Skip mountings.
p. Where are the VLT telescopes located? Why on a mountain top?
q. What is the light-gathering power of a telescope? On what does it depend?
r. What is the resolving power of a telescope? On what does it depend? Why is it relatively unimportant for ground based

telescopes? What atmospheric effect reduces the theoretical resolving power of a telescope? What are some of the advantages of a reflector over a refractor for large astronomical telescopes.
s. Active optics means that the shape of the mirror can be changed (slightly) over a few minutes to correct for the atmosphere.
t. What are some of the new large telescopes called and where are they? LBT, VLT, Keck, ... I showed pictures and discussed them in class.
u. Why are radio telescopes so big? A radio interferometer makes a lot of separate radio antennas act as a single antenna improving the resolution. One such observatory is the VLA. Where is it located? Did you see it in the movie "Contact"? We do not listen to the signal from a radio telescope with headphones.
v. Where is the Arecibo radio telescope located? (Figure 6-16)
w. We launch satellite observatories to observe in wavelengths blocked by the atmosphere or to observe without worrying about the effects of "seeing."
x. Some of the infra-red satellites were or are ISO, IRAS, and Spitzer. In the UV we have or had IUE, EUVE, and HST (Fig 6-16). In the X-ray we have CHANDRA and XMM, and Swift.
y. Skip Section 6-6
z. Try to do problem 3 on 125.

<u>Chapter 7. Starlight and Atoms.</u>
a. Remember the structure of an atom (nucleus with protons and neutrons plus electron(s) orbiting the nucleus)
b. What is meant by neutral, ionized, electron shells. Remember that all matter consists of atoms. Each atom consists of a nucleus with electron(s) in orbit around the nucleus.
c. The nucleus consists of proton(s) and neutron(s). Know what is meant by atomic number and atomic weight. What is an isotope?
d. The Coulomb force binds the electrons to the nucleus.
e. The various orbits around the nucleus are called energy levels because it takes energy to move away from the nucleus or the atom must give up energy for the electron to jump back toward the nucleus. Remember that only certain energies (distances from the nucleus) are permitted. (Stairway analogy)
f. What is an excited atom? Ground state?
g. The key concept about thermal emitters is that they emit radiation in a pattern that depends only on their temperature <u>not their surfaces</u>. So we ignore reflected light.
h. Peak wavelength, which I use in class, is the same as wavelength of maximum intensity (p. 133).
i. Look at Figure 7-6 in order to understand the three laws of thermal emission. Know the three "laws" as given in class. He leaves out the first one: That a hotter thermal emitter emits more energy at every wavelength than a cooler thermal emitter.
j. What is the Stefan-Boltzmann Law? Wien's Law? How can we use Wien's Law to determine at what wavelength a thermal emitter radiates most strongly.? The value of the constant given in class is 5000 * 6000 because I use Angstroms not nanometers.
k. Know Kirchhoff's Laws as given on page 136-137: (1) A hot solid or dense gas produces a continuous spectrum. (2) A low density excited or hot gas produces a bright, emission line spectrum. (3) Put a low density gas in front of a continuous spectrum and you get a continuous spectrum with dark, absorption lines superimposed.
l. Know emission and absorption lines and where and how they are formed.
m. What is the Doppler Effect or Doppler Shift. How can we use it to tell whether an object is moving toward or away from us? What is meant by a blue shift? A red shift?
n. Review the uses of the Doppler effect that I discussed in class.
o. Skip the Doppler formula
p. Try to do problems 1 and 2 on page 140

<u>Chapter 8. The Sun</u>
Know the data on Page 143
1. What is the photosphere, the chromosphere, the corona?
2. What is granulation? What is it telling us about heat flow from the interior? How long does a granule last?
3. What is convection? Conduction? Radiation? (Discussed in class)
4. What is supergranulation? Spicules are found at the edges of supergranules. How long do they live?
5. How does the temperature of the Sun's visible layers vary with height above the photosphere? (Figure 8-3)
6. How far does the Corona extend into space? How hot is the corona? What is the Solar wind?

7. Helioseismology is the study of the interior of the Sun using the Sun's oscillations in radius. We can study the interior of the sun just as ringing a bell tells us how the bell is made. (Figure 8-7)
8. What are Sunspots? (Look carefully at Figure 8-8: Never stare or point a telescope at the Sun)
9. What is the 11 year Sunspot cycle? The 22 year magnetic cycle? (Page 152-153)
10. What are flares, prominences, filaments? (Page 158-159)
11. What is the butterfly diagram (P. 152-153)? What does it tell us about the Sunspots during the cycle?
12. What is the Maunder minimum in the numbers of Sunspots?
13. Where does the energy from the sun come from? Why do we know that it must be nuclear energy?
14. Binding energy is the energy that keeps the protons and neutrons in the nucleus from flying apart.
15. Nuclear Fusion requires high temperatures and high densities to overcome the Coulomb barrier. (Because like charges repel)
16.What is the proton-proton chain? (See Figure 8-14)
17. What is a neutrino? How is energy released in the proton-proton chain? Deuterium is an isotope of hydrogen.
18. How does the energy flow from the center to the surface? Where is convection important? Radiation?
19. What is the difference between nuclear fusion and nuclear fission. Which is most important in current nuclear power plants like Palo Verde?
20. What does the solar neutrino experiment tell us? What are the most recent results: Discussed in class.
21. Who is the astronomer who built the Homestake Mine experiment and was awarded the Nobel Prize?