

1. **YOU MUST NOT USE YOUR LAPTOP, TABLET OR YOUR CELLPHONE**
 - a. Bring a calculator –(NOT the one on your cellphone) Do Not cheat off your neighbor!
 - b. Bring a Number 2 Pencil and an eraser.
2. **HINTS ON TAKING "OPEN NOTES" TESTS-- WHEN STUDYING:**
 - a. Carefully read the Chapter Summary, learn the "New Terms"
 - b. Try to do the Review Questions, and the Discussion Questions.
 - c. Work as many problems as you can. Feel free to ask me if you are having problems doing them.
3. **TAKING THE TEST**
 - a. **Read the test questions carefully!**
 - b. Go through the test once and answer all the questions that you can. Then go back and do the other questions.
 - c. You may mark on the test booklet: cross off obviously wrong answers, work the problems, and show your work.
 - d. Circle the answer on the test booklet - this is the last resort if you have made a mistake on the answer sheet.
 - e. Carefully darken in the answer on the answer sheet, do not rip, mutilate, fold, or spindle it.
 - f. Check your answer sheet. Make sure you have answered all 50 questions.
 - g. **MAKE SURE THAT YOUR NAME IS ON THE ANSWER SHEET AND YOU HAVE PUT IN YOUR FULL UNIVERSITY ID NUMBER-LEFT JUSTIFIED. I will subtract points if this is not done.**
 - h. **BRING A PICTURE ID.**

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?
- s. What atmospheric effect reduces the theoretical resolving power of a telescope?

- t. What are some of the advantages of a reflector over a refractor for large astronomical telescopes.
- u. Active optics means that the shape of the mirror can be changed (slightly) over a few minutes to correct for the atmosphere.
- v. What are some of the new large telescopes called and where are they? LBT, VLT, Keck, I showed pictures and discussed them in class.
- w. Why are radio telescopes so big? A radio interferometer makes a lot of separate radio antennas act as a single antenna improving the resolution.
- x. 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.
- y. Where is the Arecibo radio telescope located? (Figure 6-16)
- z. We launch satellite observatories to observe in wavelengths blocked by the atmosphere or to observe without worrying about the effects of "seeing."
- zz. 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, XMM, and Swift.
- zzz. Skip Section 6-6
- zzzz. Try to do problem 3 on 125.

Chapter 7. Starlight and Atoms.

- 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 orbits. 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 not their surfaces. 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 on page 139
- p. Try to do problems 1 and 2 on page 140

Chapter 8. The Sun

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?

Chapter 20: Planet Earth

[Know the celestial profile for each Planet]

1. What are the 4 stages of planetary evolution: differentiation, cratering, flooding, slow surface evolution? What is comparative planetology? (Figure 20-2)
2. What are the four processes that effect the geology of the earth and the other inner planets: impact craters, volcanism, plate tectonics (or its absence), and erosion.
3. What is seismology? How are pressure or p-waves and shear or s-waves used to determine the internal structure of the Earth?
4. What are the various parts of the interior of the earth and where are they located? The four layers of the Earth are the inner solid core, the liquid core, the mantle, and the crust. Why is the core thought to be iron rich material?
5. What are the heat sources in the Earth's interior? How do we know the ages of the rocks?
6. The Earth has a magnetic field that protects us from particles emitted from the Sun. What are the Van Allen Belts? How is the Earth's magnetic field like a bar magnet? What is the evidence that the direction of the magnetic field changes with time?
7. What is the relationship between the Aurorae and the Earth's magnetic field and radiation belts?
8. What is Plate Tectonics? How are the mid ocean rise and mid ocean rift connected?
9. What is a subduction zone (See pages 442-443)? What is basalt rock formed out of?
10. What mountain range is formed from the collisions of plates? (Himalayas)
11. A rift valley is formed when a crustal plate splits. Where is the crust of the earth thinnest? Thickest?

12. What will the continents look like in about 250 million years ? Plates can slip along each other.
13. What is the evidence for plate tectonics and continental drift? What is a Convection Cell and how does it transfer heat from the interior to the surface? What is Magma?
14. The Hawaiian Islands are caused by a hot spot in a plate which brings magma to the surface and the overlying plate moves with respect to the hot spot. They are shield volcanoes.
15. What is the composition of the Earth's atmosphere? How is it similar to and different from other planetary atmospheres such as Mars and Venus?
16. What probably happened to Earth's first atmosphere? What is the source of our current atmosphere?
17. What is the source of the oxygen in the atmosphere?
18. What is the Greenhouse effect? What are the Greenhouse gases? Where else is the Greenhouse effect important in the solar system?
19. Our water probably came from outgassing via volcanoes and maybe the result of cometary impact.
20. Since the Earth did not freeze, the oceans could absorb carbon dioxide and reduce the amount of Greenhouse gases in the atmosphere.
21. Venus was so hot that water vapor escaped and allowed carbon dioxide to increase and produce a runaway Greenhouse effect.
22. What is meant by the Albedo of a planet?
23. What is global climate change and how is it related to the amount of carbon dioxide in the atmosphere?
24. Where is the Ozone layer located? Why is the Ozone layer important to life?
25. What human effects have changed the ozone layer?
26. How does the depletion of Ozone affect life on the earth? What causes ozone depletion?
27. The best discussion of Volcanoes can be found on pages 478-479.