CHAPTER 21 - SUPERPOSITION

Physics for scientists and engineers: A strategic approach; Randall Knight, 2^{nd} ed.
**** also includes a PhET component (below)**

21.1 The Principle of Superposition. Make sure you understand why the resulting forms look the way they do (because of superposition). Try not only to visualize the superpositions, but also to actually DRAW it.

21.2 Standing Waves. Read this section carefully (it will also help for the lab) and pay attention to Fig 21.5 and 21.6. Concentrate on how a standing wave is created, become familiar with nodes and antinodes, and look at how a standing wave is represented in equations. Compare the equation for a traveling wave to that of a standing wave. Why is the amplitude 2a? Is the wave moving? Pluck a rubber band and observe the wave pattern at its fundamental frequency.

21.3 Transverse Standing Waves. This is either preparation or review of your lab experiment. You may skip the section on standing electromagnetic waves (although it is interesting).

21.4 Standing Sound Waves and Musical Acoustics. Compare Fig. 21.16 to 21.11: Only certain wavelengths fit on a string or inside a tube. Make sure you understand what the boundaries (open or closed tube) impose on the wavelengths and where equations 21.17 and 21.18 come from. Look carefully at both examples.

21.5 Interference in One Dimension. This is one of the key sections that you simply *must* understand. Interference is a consequence of superposition, and constructive and destructive interference are connected to certain phase differences between two waves. It is very important to get used to the notations used to express phase differences. Make sure you can follow example 21.8 and look at Stop To Think 21.4

21.6 The Mathematics of Interference - You may skip Application: Thin-Film Optical Coatings for now -- we'll return to this later. Although you are not required to derive eq 21.27, you *should be able to follow* the arguments that lead to constructive and destructive interference. Make sure you understand example 21.9, which has BOTH a phase difference AND a path length difference between the two speakers. This is needed when the speakers do not generate their wave in phase.

21.6, subsection Application: Thin-Film Optical Coating*. This interference is a mix of BOTH phase difference (from the reflection) and path difference (distance traveled inside the film). It is *important* to note that the wavelength INSIDE the film will change. This needs to be carefully taken into account. **this was section was assigned separately.*

21.7 Interference in Two and Three Dimensions. Try to understand Figure 21.28 (Fig. 21.27 in 1st edition), as there is a lot of important information in there. It is also very helpful to look at Fig. 21.30 and example 21.11 & 21.12. Concentrate on the examples and the problem-solving strategy.

21.8 Beats - read this section carefully. Try to explain in your own words what the average frequency and what the beat frequency is. Carefully look at Fig. 21.32. Think of a situation where a beat frequency could arise -- what does a beat frequency sound like?

**COMPUTER SIMULATION:

THIS WEEK: Using a PhET simulation to answer questions (its just like playing a game!). PhET simulation: go to http://phet.colorado.edu/en/simulation/sound and play with the sound applet. Go to the "Two Source Interference" (tab along the top) and click on "audio enable". Move the listener around and note what the interference pattern looks like for positions where the sound increases or decreases.