

**Let There Be Light**

1. Since your shirt is not very hot, it must radiate relatively low energy light (thus NOT in the visible part of the spectrum). Therefore, how does it get its color?

What is the peak wavelength of radiation from the solar surface (6000K)? What part of the spectrum does this correspond to (be specific)? Based on your answer, why does the sun look yellow? (HINT: Why is the sky blue?)

2. Microwave ovens work by dosing your food with microwaves (waves on the border between IR and radio) which then causes the water molecules in your food to heat up. Humans are made of mostly water and are thus very strongly (and negatively) affected by microwaves (anyone see the movie *Batman Begins*?). Also, if you've ever noticed, there's always a mesh screen with little holes on the front of any microwave. Clearly we can see through the little holes and watch our food cook inside, but why have the mesh screen at all? If I want my microwave to be safe, but I also want to be able to watch my food cook, what range of sizes can I use for the mesh screen.

So pretty much everyone's noticed that you lose cell phone reception or radio reception when you go in an elevator or in your car through a tunnel or even when you're driving across the Bay Bridge, right? Knowing that cell phone radiation and radio radiation are both made up of radio waves and also that metal structures tend to block E-M radiation with wavelengths that are bigger than the spacing between the metal beams<sup>1</sup>, explain why I can't get good radio reception on the Bay Bridge. A related question: why do I not need to use my headlights (during a clear day at least) on the Bay Bridge?

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<sup>1</sup> This effect is known as being inside a Faraday cage and is very annoying to radio and cell phone engineers, as well as college students who get zero cell phone reception in their cheaply built dorm rooms.

**3.** If the speed of sound is 1000 km/hr, by what percentage does the pitch (frequency) of a police siren change if it is coming towards you down the freeway at 100 km/hr compared with how it sounds after it pulls the guy over and is at rest (assume you are stationary)? Does it sound higher or lower in pitch as it comes toward you?

In order to get the same percentage change in the *color* of the police lights, how fast would the car have to go? If the car was actually traveling at this speed and assuming that the car has the usual blue and red police lights (as observed when the car is at rest), what would the lights look like?

**4.** What is angular resolution? Why do astronomers like to build large telescopes? What advantages do large telescopes have in light-gathering power and resolution (use equations as well as words)? Why are these important characteristics of a telescope (what good are they to astronomers)?