

## PowerPoint Notes on Electromagnetic Waves

### Slide 1

### Slide 2

This information will be particularly interesting to students who have studied electromagnetism already. These students may recognize the constants  $\epsilon_0$  and  $\mu_0$  as the permittivity and permeability of a vacuum, respectively.

### Slide 3

The electric and magnetic fields oscillate perpendicular to each other and to the direction of wave propagation.

### Slide 4

### Slide 5

### Slide 6

### Slide 7

Point out that the frequency scale is logarithmic on this diagram, indicating the huge range of frequencies between radio and gamma rays.

### Slide 8

Sometimes indigo is included in a list of colors in the visible spectrum, and sometimes it is not. Newton originally only identified five colors (Red, Yellow, Green, Blue, Violet), but later added Orange and Indigo so that the number of colors would be seven and thus analogous to the number of notes in the musical scale.

### Slide 9

Point out to students that this is classic illustration of a classic experiment, first published by Newton in the early 1600's. This is proof that white light is not its own color but instead consists of the combination of the other colors in the spectrum.

### Slide 10

### Slides 11 and 12

Gamma – Irradiating food to kill bacteria. Radioactive sources for radiation therapy in cancer patients. A new system called VACIS (vehicle and container imaging system) uses gamma rays to check containers for stowaways and other contraband.

X-Rays – Used to take pictures of inside the body. X- Rays can penetrate tissue but not bone.

Ultraviolet – Used for tanning and detecting forgeries on checks and credit cards.

Visible – Used for seeing and for lasers.

Infrared – used for cooking and thermal imaging, and ear thermometers

Microwaves – used for cooking, since water oscillates at microwave frequencies, creating friction and therefore heat in food.

Radio Waves – used for radio, tv, cell phone, and satellite signals

**Slide 13**

**Slide 14**

**Slide 15**

Infrared observing really can be done from Earth, provided the telescope is above much of the water vapor in Earth's atmosphere.

**Slide 16**

This image was found at <http://www.teachersdomain.org/resource/phy03.sci.phys.mfw.chandra/>

**Slide 17**

The MOSAIC system will detect any frequency emission at 11.07 GHz along the path it is pointed. In the US, this band is relatively quiet from television and other manmade frequencies, but this is the frequency used for satellite television in Europe. The ozone in the lower atmosphere certainly emits some radiation at 11.07 GHz, and it will be detected by MOSAIC along with mesospheric ozone (but the signal is pressure-broadened, making it easy to remove in analysis). Further, any radio sources from space that happen to pass through the line of sight of MOSAIC will be measured if they emit significant radiation at 11.07 GHz.