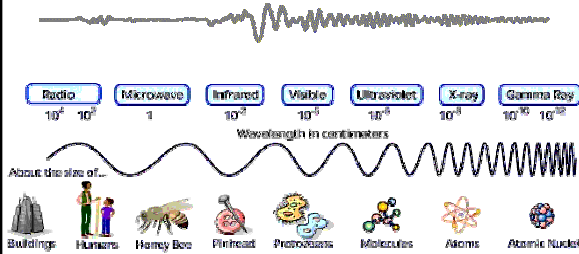


Waves



Mechanical & Electromagnetic

Ch. 10

1

Objectives

1. **Recognize** that waves transfer energy.
2. **Distinguish** between mechanical waves and electromagnetic waves.
3. **Explain** the relationship between particle vibration and wave motion.
4. **Distinguish** between transverse waves and longitudinal waves.

2

Types of Waves

- **Mechanical**
 - A wave that requires a medium through which to travel
- **Electromagnetic**
 - A wave caused by a disturbance in electric and magnetic fields
 - does not require a medium
 - also called a light wave

3

Let's begin with Mechanical Waves

- Sound is a mechanical wave



The sound produced by the bell cannot be heard since sound cannot travel through a vacuum.

4



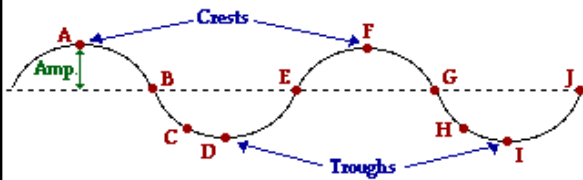
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Connection...

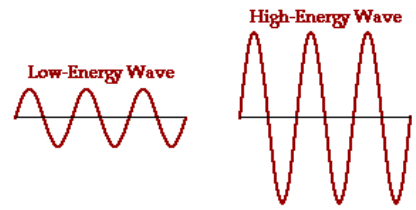
- Ordinary ocean waves are produced by wind,
- so wave power is just another form of wind power.
- Winds are caused by differential heating of Earth by the sun
- So, wave power is another form of solar power.

6

Properties of Waves



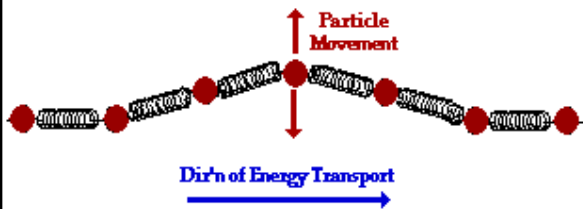
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The amplitude of a wave is related to the energy which it transports.

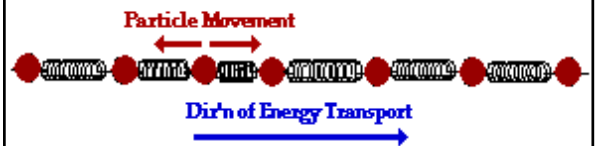
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Transverse Wave



9

Longitudinal Wave



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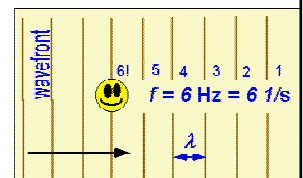
Wave Speed

- Wave speed equals frequency times wavelength $v = f\lambda$
- A wavelength is how fast a wave moves in a certain amount of time



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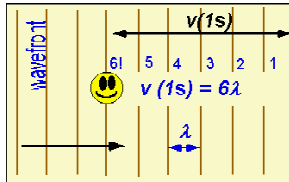
- Suppose that six waves pass a point in one second.
- Here the waves move from left to right and the sixth wave is just passing.
- The frequency is 6 cycles per second or 6Hz.



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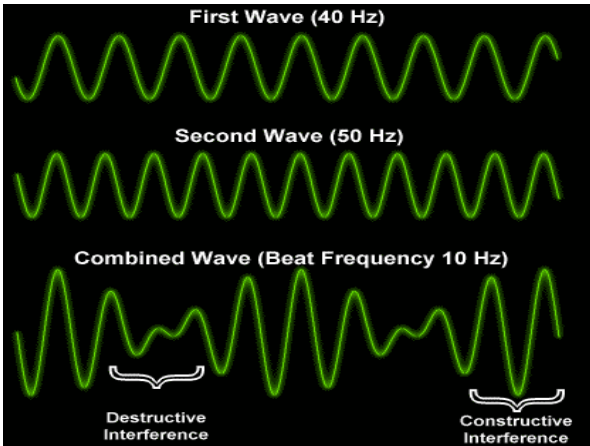
- Suppose that the frequency is 6Hz and watch for one second.

- Six waves, each one wavelength long, pass by. Each wavefront travels 6 wavelengths in one second.



Interference

Constructive & Destructive



Now let's take a look at

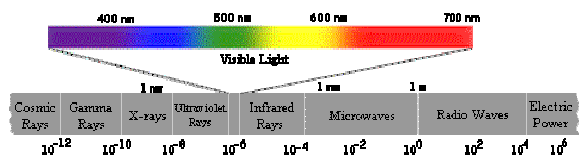
Electromagnetic Radiation

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WAVELENGTH

- The distance between two high points or low points.
- All types of light move in a wave-like pattern. There are high points and low points in that wave pattern.
- The energy that comes to the Earth from the Sun comes in the form of light and heat.

All of the wavelengths of light together are called the EM (electromagnetic) **SPECTRA**.



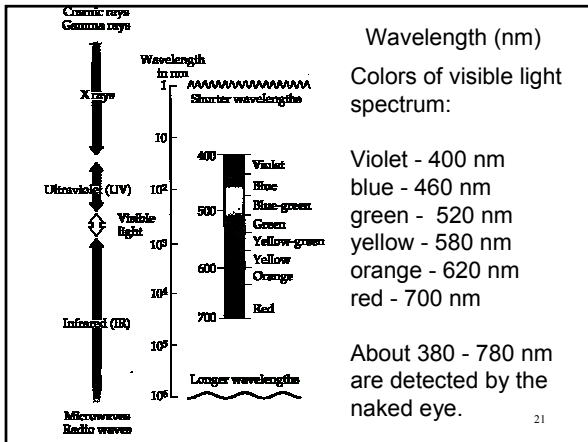
Scientists measure wavelengths of light in **NANOMETERS**.

- Actually, the electromagnetic spectrum can be expressed in terms of energy, wavelength, or frequency.
- Each way of thinking about the EM spectrum is related to the others in a precise mathematical way.

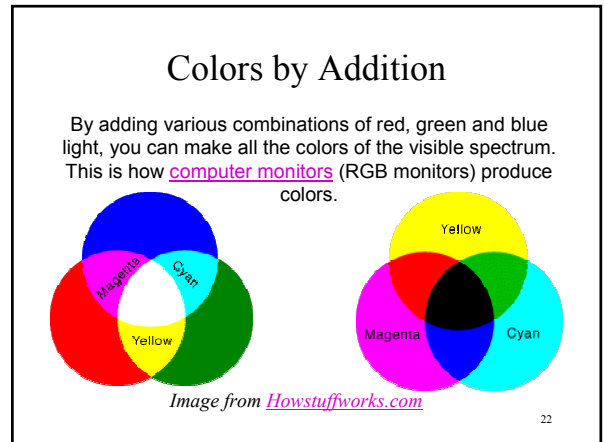
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- So why do we have three ways of describing things, each with a different set of physical units?
 - Frequency is measured in cycles per second (which is called a Hertz)
 - wavelength is measured in meters
 - and energy is measured in electron volts (eV)

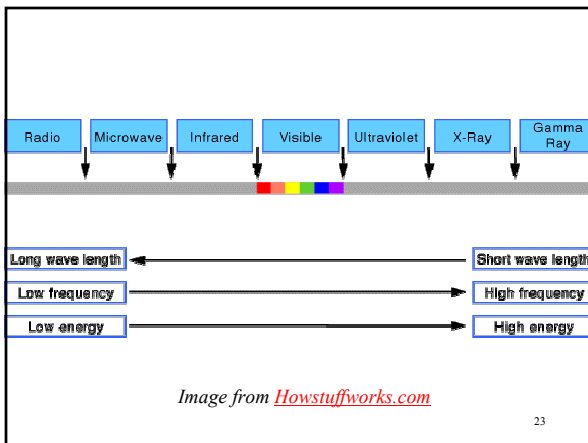
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Explaining EMS

The Electromagnetic Spectrum

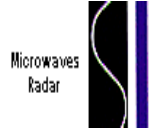
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Radio Waves

- This is the same kind of energy that radio stations emit into the air.
- Radio waves are also emitted by other things, such as stars and gases in space.
- You may not be able to dance to what these objects emit, but you can use it to learn what they are made of.

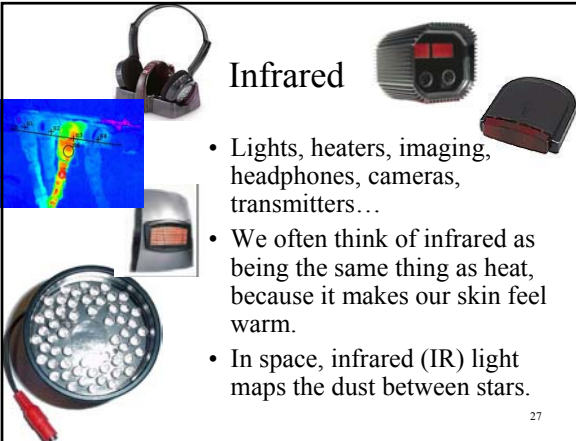
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- On Earth, microwaves are used to cook food in seconds.
- In space, microwaves are used by astronomers to learn about the structure of nearby galaxies, including our own Milky Way.



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Infrared



- Lights, heaters, imaging, headphones, cameras, transmitters...
- We often think of infrared as being the same thing as heat, because it makes our skin feel warm.
- In space, infrared (IR) light maps the dust between stars.

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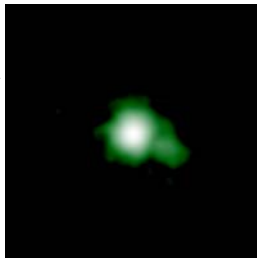
Radiation

- Visible radiation is emitted by everything from fireflies to light bulbs to stars ... also by fast-moving particles hitting other particles.
- The Sun is a source of ultraviolet (UV) radiation.
- Stars and other "hot" objects in space emit UV radiation also.

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X Rays

- Doctors use x-rays to look at bones, teeth, and tumors.
- Hot gases in the Universe also emit X-rays
- Helps measure the intensity of background radiation .

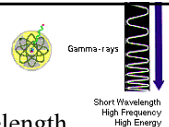


<http://chandra.harvard.edu/photo/2003/gb1508/more.html>

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Gamma Rays

- The highest energy, shortest wavelength
- Gamma-rays are rays of radioactive materials (some natural and others made by man in nuclear power plants).
- Big particle accelerators that scientists use to help them understand what matter is made of can sometimes generate gamma-rays.
- The biggest gamma-ray generator of all is the Universe. It makes gamma radiation in all kinds of ways.



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Reflection

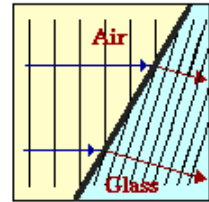
- When light hits a lake surface:
 - Some is reflected
 - Some enters the water
 - Amount reflected back depends upon the sun's angle of incidence caused by hour, season & latitude



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Refraction

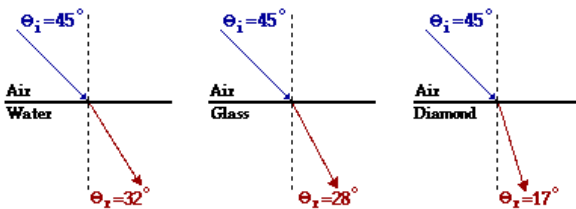
- bending of the path of light is known as **refraction**



Refraction of light occurs at the air-glass boundary.

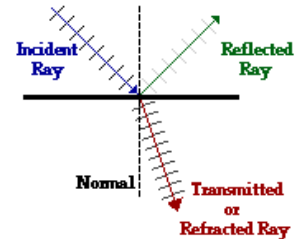
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Angles of Refraction



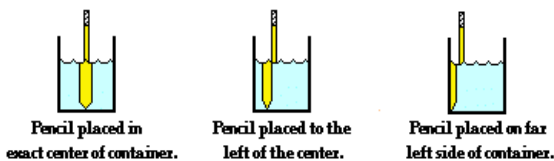
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- The angle between the incident ray and the normal is the **angle of incidence**.
- The angle between the reflected ray and the normal is the **angle of reflection**.
- And the angle between the refracted ray and the normal is the **angle of refraction**.



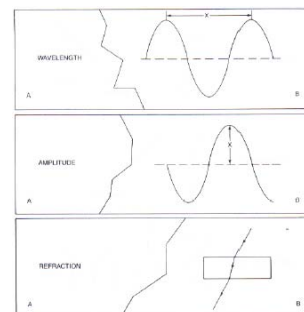
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The Broken Pencil Observation



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Study Your Wave Flashcards



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Works Cited

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- Holt Science Spectrum: A Balanced Approach
- How Stuff Works.com, retrieved December 2, 2003 from <http://science.howstuffworks.com/laser.htm/printable>
- Imagine the Universe, retrieved November 22, 2003 from http://imagine.gsfc.nasa.gov/docs/science/known_11/emspectrum.html

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Links

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<http://micro.magnet.fsu.edu/primer/lightandcolor/lightsourcehome.html>
- <http://science.howstuffworks.com/light.htm/printable>
- EM Spectrum
<http://www.colorado.edu/physics/2000/images/headers/em.gif>
<http://www.lbl.gov/MicroWorlds/ALSTool/EMSpec/EMSpec2.html>
http://imagine.gsfc.nasa.gov/docs/science/known_11/emspectrum.html

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