

Physical Science

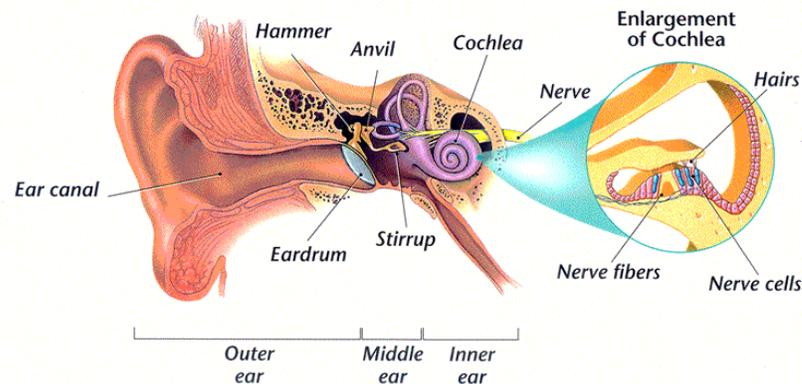
Lecture Notes

Chapters 8, 9, 10 & 11

I. Chapter 8 - Sound

- a. Sounds are longitudinal waves that require a medium to travel caused by the vibrations of an object.
- b. The speed of sound depends on the elasticity, density and temperature of the medium.
 - i. Elasticity – the ability of an object to bounce back to its original shape. Sound travels faster in more elastic objects. Typically gasses are the least elastic, liquids are next and solids are the most elastic.
 - ii. Density – generally speaking, the denser the medium the slower the sound travels.
 - iii. Temperature – generally speaking the higher the temperature the faster the speed of sound.
 - iv. Chuck Yeager – first man to fly faster than the speed of sound
 - v. Andy Green – first man to drive a land vehicle faster than the speed of sound.
- c. Properties of Sound
 - i. Intensity – the amount of energy the wave carries per second per meter squared
 1. intensity = Watts / m²
 - ii. Loudness – sound level is measured in decibels (dB)
 1. whisper = 20 dB
 2. rock concert = 115 dB
 3. rocket engine = 200 dB

63 The Ear



d. Human Sound

- a. Converting sound waves (vibrations) into sensory impulses interpreted as sound.
- b. Three parts to your ear: Outer Ear, Middle Ear and Inner Ear
 - i. **Outer Ear:** The funnel shaped **ear flap (pinna)** and the **auditory canal** direct sound to the **eardrum (tympanum)** which separate the outer and middle ear
 - ii. **Middle Ear:** The sound waves vibrate the tympanum which causes the three smallest bones in the body to also vibrate. These bones (in order) are the **Hammer (Malleus)**, **Anvil (Incus)** and **Stirrup**

(Stapes). The end of the stirrup vibrates a thin membrane, the **Oval Window**, covering the inner ear. The **Eustachian tube** connects the middle Ear with the back of the throat (Pharynx) to allow atmospheric pressures to equalize on each side of the **tympanum**.

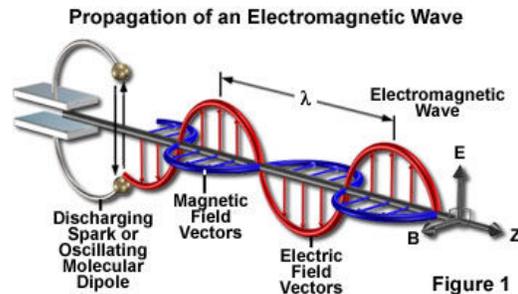
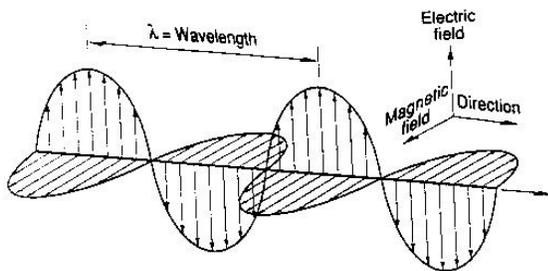
- iii. **Inner Ear:** The **Oval Window** separates the middle and inner ears. This membrane touches the fluid filled chamber of the **cochlea** causes the **Cochlea** to vibrate. The inner surface of the cochlea is lined with tiny nerve receptor **Hair Cells**. These receptors stimulate the neurons of the **auditory nerve** (**Vestibulocochlear Nerve**) which carries impulses to the cerebrum where it is interpreted as sound.

I. Chapter 9 Section 1 – The Nature of Electromagnetic Waves

A. EMR requires no medium to travel- can travel thru a vacuum

B. Consists of changing electric and magnetic fields

- 1. Electric field is a region where particles can be pushed or pulled.
 - a. Wherever there is an electric charge there is an electric field associated w/ it.
 - b. A moving electric charge is part of an electric current
 - c. An electric current is surrounded by a magnetic field
- 2. A magnetic field is a region in which magnetic forces are present
- 3. When electric field changes – so does the magnetic field.
 - a. When one vibrates--- so does the other



C. Speed

- 1. 300,000,000 meters /sec
- 2. 186,000 miles /sec

D. Wave or particle?

- 1. Acts like a wave when passing thru a polarizing filter

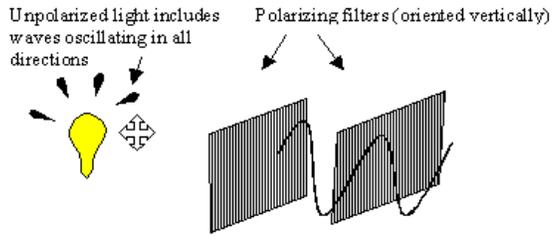


Figure 2a: Light from an incandescent bulb vibrates in all directions. Two vertically oriented polarizing lenses will allow only the vertically polarized light through and will block out the horizontal components.

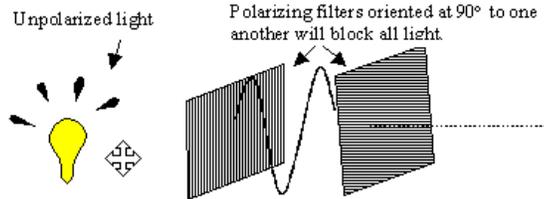
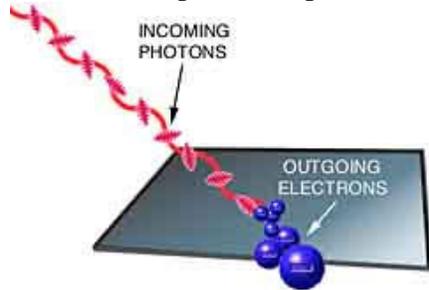
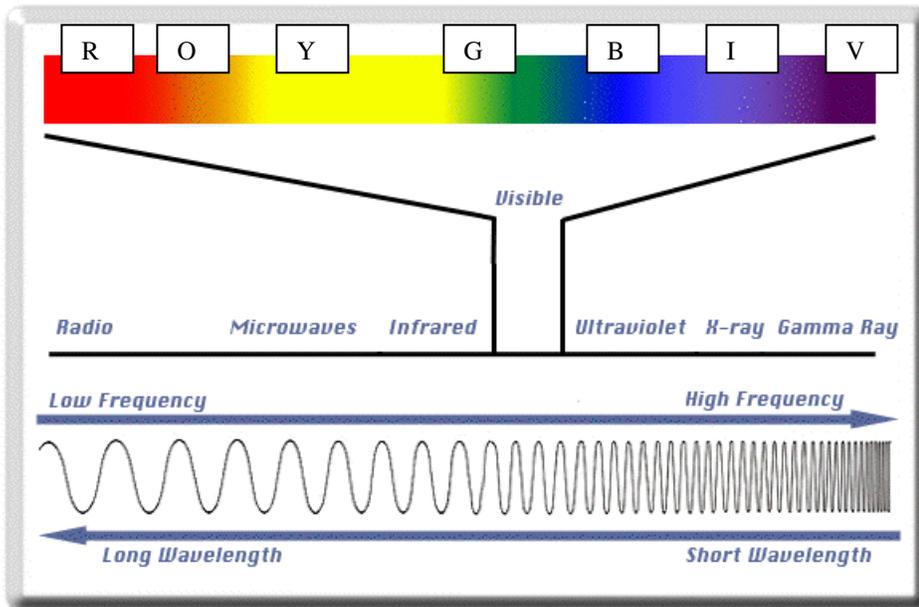


Figure 2b: When the two polarizing filters are placed perpendicular to one another, the first will block all but the vertically polarized waves while the second is oriented only to allow horizontally polarized waves to pass.

2. Acts like a particle – photoelectric effect



E. Waves of the EMS



A. When light strikes an object

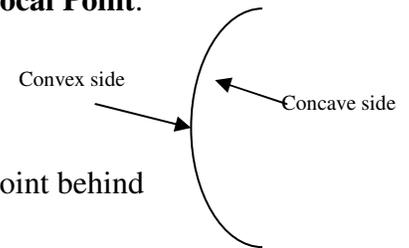
1. It is either reflected, absorbed or transmitted.
 - a. **Opaque:** a material that reflects or absorbs the light – can't see through it. - wood
 - b. **Transparent:** The material transmits light – allows light to pass through it – glass
 - c. **Translucent:** allows some light to pass through – can't see image clearly – wax paper, frosted glass.

B. Kinds of Reflection

1. You see objects because light is reflected, bounced off of it.
2. **Law of Reflection:** Angle of reflection equals the angle of incidence –
 - a. Angle coming in = angle going off
3. **Regular Reflection:** reflection off smooth surface – a mirror
4. **Diffuse Reflection:** Irregular or bumpy, uneven surface – wall

C. Mirrors

1. **Image:** a copy of an object formed by reflected or refracted light
 - a. a **virtual image:** (right side up, can see it but its not really there) appears to be coming from behind the mirror.
 - b. **Real Image:** is formed when reflected light rays actually meet at a point. The image is upside down (inverted),
2. **Plane Mirror:** a flat mirror – produces an image that is right side up and the same size as the original object –
3. **Concave Mirrors:** a mirror with a surface curved inward like a “cave” or a bowl.
 - a. Light reflected comes together to meet at a **Focal Point**.
 - b. Can produce virtual or real images
 - c. Produces magnified images
4. **Convex Mirrors:**
 - a. A mirror w/ a curved surface facing outward
 - b. Reflected rays appear to come from a focal point behind the mirror
 - c. Images formed are always Virtual



III. Section 2 – Refraction and Lenses

A. **Refraction** of Light: **Bend** or change direction

1. As light rays enter a new medium the cause light to bend
2. The **denser the medium** – the **slower** the light travels
3. **Index of Refraction:** a measure of how much a medium bends the light that travels through it.
4. **Prisms:** Separates white light into its component colors.
 - a. The longer the wavelength, the less it will be bent by the prism.
5. **Rainbows-** light shining thru tiny droplets of water, each droplet acts as a prism
6. **Mirage-** is an image of a distant object caused by refraction of the light. Light travels faster in the warmer air causing light rays to bend

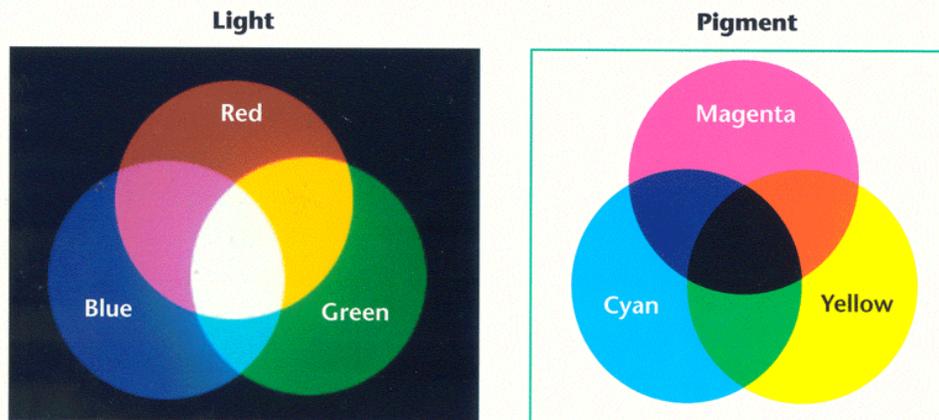
B. Lenses – a curved piece of material used to bend light

1. **Concave lenses:** as light passes through, they are bent away from the center
 - a. Images produced are only virtual, not real
2. **Convex lenses:** cause light passing through to bend toward the focal point.
 - a. The images produced depends on the position of the object

IV. Section 3 – Color

- A. The color of the object you see is the light that is reflected from its surface. All other colors are absorbed by the object.
1. Objects in white light – the color you see is due to the object absorbing all of the visible light EXCEPT the color you see. That color reflects off the object and goes into our eyes
- B. Combing colors

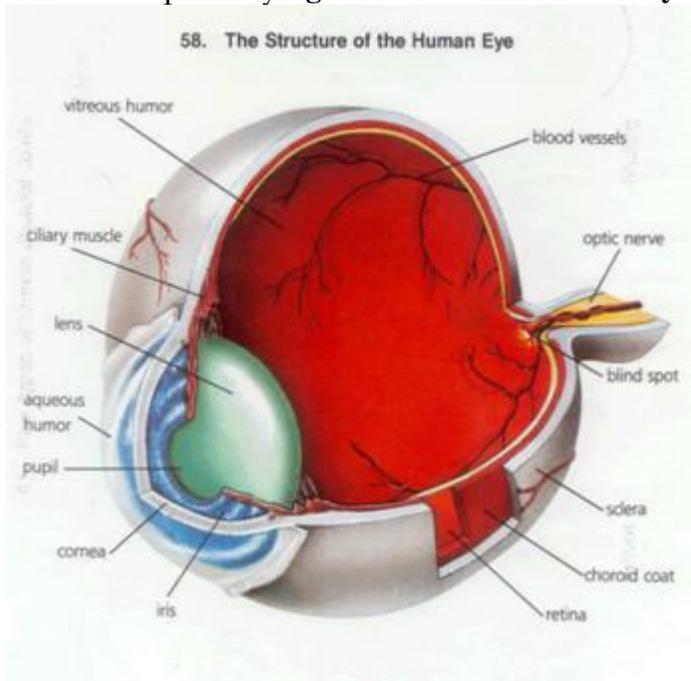
73 The Primary Colors of Light and Pigment



1. The 3 colors of light that can combine to form all other colors are primary colors –
 - a. Red, Blue, Green
 - i. Equal **Red** + Equal **Blue** = **Magenta** (secondary color)
 - ii. Equal **Red** + Equal **Green** = **Yellow** (secondary color)
 - iii. Equal **Green** + Equal **Blue** = **Cyan** (secondary color)
 - iv. Equal **Red** + Equal **Green** + Equal **Blue** = **White**
2. Any 2 colors that combine to form white are **complementary colors**
 - a. **Secondary color** + **remaining Primary Color** = **White**
 - b. **Magenta** + **Green** = **white**
 - c. **Cyan** + **red** = **white**
 - d. **Yellow** + **blue** = **white**
3. **Pigment** – substance that color other materials like paints, inks, etc
 - a. Primary Pigments are **Cyan, Yellow & Magenta**
 - b. **Cyan** + **Yellow** + **Magenta** = **Black**
 - c. **Cyan** + **Yellow** = **Red**
 - d. **Yellow** + **Magenta** = **Red**
 - e. **Cyan** + **Magenta** = **Blue**
 - f. The **primary pigments** are the **secondary light** colors!
4. **Three primary colors = three secondary pigments**
5. **Three primary pigments = Three secondary colors**

V. Seeing Color - Eye Sight

- a) Light passes thru a transparent **cornea** which begins to focus it, next to the fluid filled space called the **aqueous humor**, thru the major focusing structure, the **lens**. The lens is held in place by **ligaments** attached to **ciliary muscles** (aka. ciliary body). These



muscles contract and **change the shape** of the lens which changes the **focal point**. The **Iris** is the color part of the eye and regulates how much light is allowed into the eye through the **pupil**. The light then passes thru a fluid (**vitreous humor**) and focuses on the back of the eye, the **retina**. The central region where images focused is the **fovea**. Light sensitive structures detect light/dark and movement are **the rods** (about 1 billion). Color is detected

by **cones** (about 3 million). The impulses generated by the rods & cones are transmitted to the brain via the **optic nerve**. The large white ball of the eye is the **Sclera**

- b) **Nearsighted**: Ability to see “near” items where far items are out of focus – caused by focal point in front of the retina
- c) **Farsighted**: Ability to see “far” items whereas near items are out of focus – caused by focal point of the lens being beyond the retina

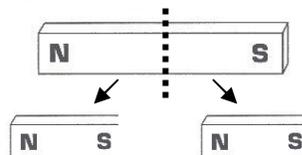
VI. Chapter 11 – Magnetism and Electromagnetism

A. Magnets

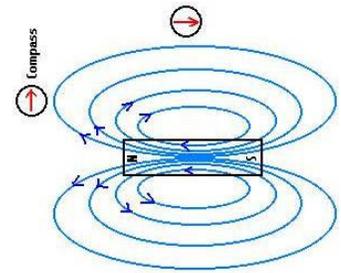
1. A special stone first discovered <2000 years ago in Greece, in a region called “**Magnesia**”, attracted iron, they called it “**magnetite**” hence the “magnet” name.
2. About 1000 years ago they noticed that a hanging magnet always pointed to the North Star A.K.A “**Lodestar**”. Hence the other name for naturally occurring magnets – “**lodestone**”

B. Magnetic Poles – the ends of the magnet, area where the magnetic effect is the **strongest**.

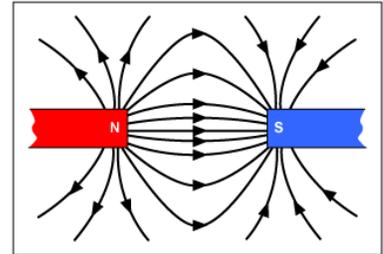
1. If a bar magnet is suspended by a thread or string, it will align itself so that one strong end points north and the other points south, hence the names for the “North” and “South” poles of the magnet.
2. **Like poles of separate magnets repel** – push away from – each other
3. **Unlike poles attract each other**
4. If you snap a magnet in half, the inside pieces become the opposite poles:



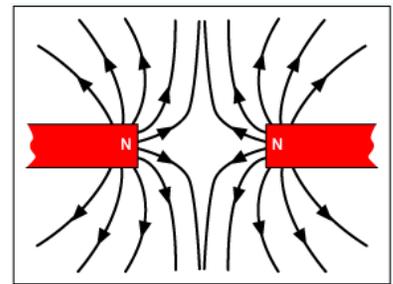
- C. **Magnetic Fields** – that region around a magnet that is affected by the magnet. Strongest at the poles, the Force forms lines that go out of the North Pole and wrap back around to enter in at the South Pole.



- D. Magnets attract because force comes out of North Pole and goes into the South Pole



- E. Magnets repel because the forces are pushing away from each other

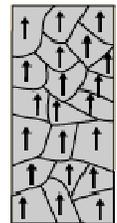


F. Inside a magnet

1. At the atomic level, there are **protons** (+ charge) & **neutrons** (neutral charge) in the nucleus, and **electrons** (- charge) spinning in orbits around the nucleus. The moving electron acts as a mini electrical charge and therefore has a magnetic field associated w/ it.
2. In ferrous materials clusters of atoms align there atoms w/ one another. A cluster of billions of atoms w/ magnetic fields aligned is called a **domain**.
3. When domains are randomly arranged – forces cancel each other out. – no net magnetic affect
4. When domains have their magnetic affect in alignment - – forces are additive and create a strong magnetic affect



In bulk material the domains usually cancel, leaving the material unmagnetized.



Externally applied magnetic field.

G. Making Magnets

1. Since Magnetism and electricity are so closely related, it is relatively easy to make magnets
2. **Temporary magnets** – materials that become magnetized while in contact w/ strong magnets – ie a paperclip is able to pick up more paper clips when stuck to a strong magnet
3. **Permanent magnets** – materials that maintain their magnetism when the magnet is removed from it.

H. Destroying & Breaking magnets –

1. Magnets that are dropped, or struck hard will cause the domains to misalign.
2. Heating also causes the atoms to vibrate faster and faster allowing the domains to misalign.

I. Magnetic Earth

1. **Earth's core is Iron** – Earth is a giant magnet
2. Earth's magnetic north pole is not the same as Earth's axis north pole. It is about 1250 km (776 miles) away from the **true north** pole
3. The angle between true north and magnetic north is **the magnetic declination**.

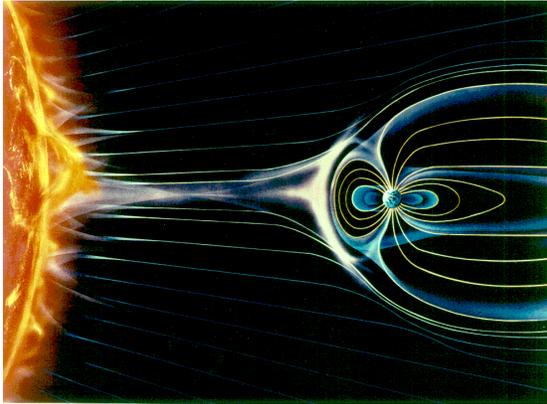


Diagram showing the magnetic force field surrounding the Earth. The Solar Wind compresses the force field on the Sun side and is deflected by the force field known as the **Magnetosphere**

J. Electric Current & Magnetic Fields

1. When electric charges run thru a wire they create an electric current – a flow of charge thru a material
2. An electric current produces a magnetic field
3. Electric circuit – a complete path through which electric charges can flow
 - a. Each circuit has a source of electrical energy
 - b. Have devices that are run by the electric current
 - c. Connected by conducting wires and a switch
4. Conductors & Insulators
 - a. Conductors allow current to flow easily
 - i. Their electrons are loosely bound to their atoms
 - ii. Metals – copper, silver, iron, superconductors
 - b. Insulator – do not allow current to flow easily
 - i. Electrons are tightly bound to atom
 - ii. Plastic, wood, rubber, sand, glass
5. Electrical Resistance – a substance that utilizes electrical energy as it interferes w/, resists