Name _____ Section _____

Period 3 Activity Sheet: Electromagnetic Waves – Radiant Energy II

3.1 Mirrors and Lenses

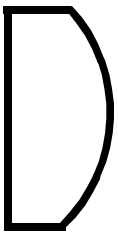
1) Your instructor will show you how to use the light box and a plane mirror to determine the angle of reflection of light from a mirror.

   a) Draw a diagram showing light beams striking and reflecting off of a plane mirror.

   b) How does the angle that light strikes a mirror (the angle of incidence) compare to the angle that light is reflected from the mirror (the angle of reflection)?

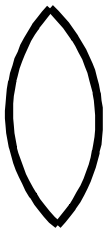
2) Shine light from the light box onto the surface of a curved mirror. Draw light beams on the diagrams below showing the path of the light reflected from the mirror. Which type of mirror focuses light? _____

Concave Mirror

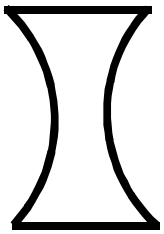


Convex Mirror

3) Shine light from the light box onto the surface of a concave and a convex lens. Draw light beams on the diagrams below showing the path of the light traveling through the lens. Which type of lens focuses light? _____



Convex Lens



Concave Lens

4) Group Discussion Question: Give some example of mirrors and lenses used to focus light.

5) **Polarized Light** Your instructor will discuss polarization of light.

   a) Look at the OHIO sign and the reflection of the sign. Now view the sign and its reflection through a polarizing filter. Describe what happens when you rotate the polarizing filter.

   b) Why does rotating the polarizer have this effect?

6) **Fluorescence** Your instructor will demonstrate the results of shining several types of radiant energy on fluorescent materials. What happens when an atom fluoresces?

   a) Which light source works the best? _____

   b) Will the glow coil provide suitable light for the materials to fluoresce? _____

      Why or why not?

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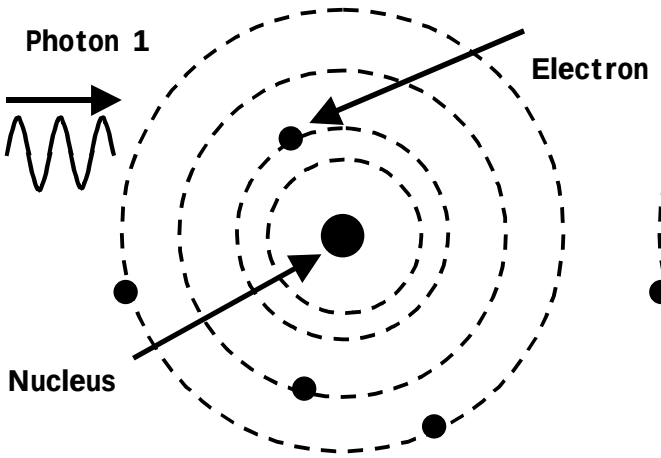
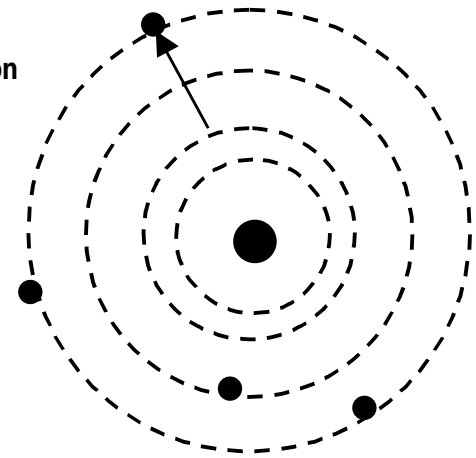
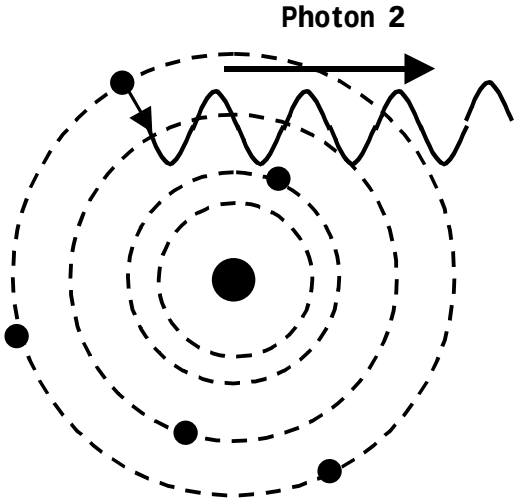
7) The diagrams below illustrate an atomic nucleus and energy levels of the atom's electrons (not draw to scale). In diagram #1, an electron has absorbed a photon and has moved to a higher energy level. Diagram #2 shows the same atom some time later, after the electron has emitted a photon and dropped to a lower energy level. Answer the questions below based on these diagrams.



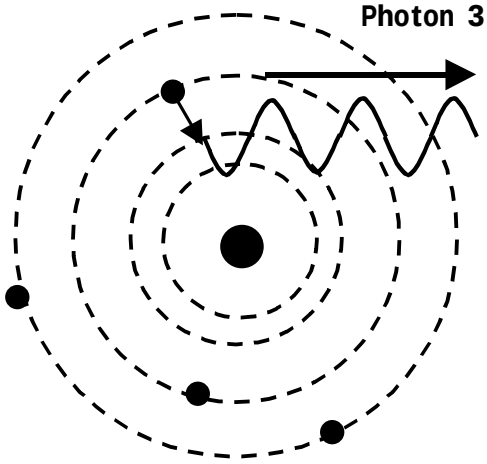
Time 1: An ultraviolet light photon is absorbed by an electron.



Time 2: The electron moves up two energy levels.



Time 3: The electron drops down one one energy level and emits one photon of visible light.



Time 4: The electron drops down one more energy level and emits a second photon.

a) Does the absorbed photon #1 or the emitted photon #2 have more energy? ________________ How do you know?

b) Which photon has a larger frequency, the absorbed or either of the emitted photon? How do you know?

c) Which photon has a longer wavelength – the absorbed or the emitted photon? How do you know?

d) If the absorbed photon #1 is a photon of ultraviolet radiation, what type of radiation could emitted photon #2 be?

e) Compare the energy of photon #1 to the energies of photons #2 and #3.

f) How can the visible light given off by fluorescing materials be explained in terms of the energy of photons?

8) "Write" on the Write and See boards using light from the red pen and then light from the blue pen.

a) Does the red pen leave an impression on the board? _____

Does the blue pen? _____

b) Explain the difference between the red and blue photons in terms of the quantum model of electromagnetic radiation.

9) Your instructor will demonstrate several light sources. Look at the light through a diffraction grating.

a) Describe what you see when you view an incandescent and a fluorescent bulb through the grating.

b) What do you see when you view the glass tube with mercury vapor through the grating?

c) What do you see when you view the glass tube with neon vapor? Why do you see distinct lines?

Name _____ Section _____

3.2 How is Information Transferred with Radiant Energy?

10) Your instructor will discuss information transfer. What are the requirements for the transfer of information?

11) Your instructor will demonstrate noise in a signal with a slide projector.

a) List two changes that improve the signal-to-noise ratio.

b) If the average energy of the noise is doubled, what must happen to the average energy in the signal if the signal-to-noise ratio is to remain unchanged?

12) Your instructor will discuss what is meant by encoding information for transfer. List at least 3 schemes for encoding information.

13) What is a pixel? Look for pixels in the pictures on your table.

14) Using Morse code and telegraph keys, have a contest between two groups at your table. Try to send and successfully receive your Mother's first name. Is Morse code an analog or a digital signal? Why?

15) Your instructor will discuss how electromagnetic signals are transferred.

a) List 3 common mediums through which an electromagnetic signal can be transmitted.

b) How does a fiber optic cable transmit information? How is it possible for a signal to be transmitted through a bent cable?

c) How do coaxial cables transmit information?

3.3 How Are Signals Broadcast?

16) **Microwave transmissions** Use a microwave transmitter to send microwaves to the microwave receiver.

Try to shield the signal using a sheet of aluminum, a glass plate, and a metal grid. Try to reflect the microwave signal using the same materials. Record your results below.

	Shields waves?	**Reflects waves?**
a) Aluminum sheet	_____	_____
b) Glass plate	_____	_____
c) Grid held horizontally	_____	_____
d) Grid held vertically	_____	_____

e) Why do different orientations of the metal grid give different results?

f) Group Discussion Question: Why do microwave ovens have a glass door with metal gratings?

17) **Radio and Television Broadcasts** Your instructor will discuss broadcasting.

a) How is it possible that every radio station transmits its signal at a distinct frequency while sending a signal made up of a variety of frequencies (musical pitches)?

b) A radio station transmits radio waves with a wavelength of **3.3** meters. What is the frequency of the station?

_____

18) **Broadcasts with visible light.**

a) Connect a solar cell to the white amplifier/loudspeaker. What happens when an LED flashlight connected to a radio shines on the solar cell? What type of radiant energy transfers information?

b) Your instructor will show you how to use a laser beam to send a modulated signal to a solar cell.

1) How is energy transferred from the radio to the laser beam?

2) How does the modulated laser beam produce sound in the second loudspeaker?