BLACK BODY RADIATION LAB

MONROE

Time Frame:	Standards:
1 hour of preparation by instructor 45 minutes of class by students	Standard 2, Goal 2.2, 2.3, 2.4

Objectives:

Students will observe the movement of energy through electromagnetic waves and will practice graphing skills when showing results of the laboratory experiment.

Background Information:

Radiant energy is the only form of energy that is able to pass through a vacuum. It is a property of the electromagnetic force and it is carried by a massless particle called a photon. Radiant energy moves in waves and is classified radiant energy by its wavelength. Energy with the shortest wavelength is called Gamma, followed by X-ray, Ultraviolet, Visible, Infrared, Microwave and finally Radio waves. Many people will also include refinements of radiant energy into even smaller groups.

Gamma waves may also be called Gamma Rays, and they are very energetic. Gamma radiation is very damaging to living tissue and can be used as both a weapon of destruction and an agent of purification. Radio waves can be detected by average A.M. and F.M. tuners. Their wavelengths can be measured in hundreds of meters to kilometers in length. Ultraviolet lights can cause sunburns and some skin cancers. It is easily blocked by sunscreens with a high S.P.F. number. S.P.F. is an acronym for Sun Protection Factor. An S.P.F. of 45 would have a protection factor of 45 times that of unprotected skin. Ultraviolet light is blocked by the Ozone in the Stratosphere.

Infrared is sometimes called the heat wave. This is a bit misleading because not all infrared energy comes from hot objects. All objects give off infrared energy. Infrared light is also given off by the heat lamps in fast food restaurants. All things that have temperature give off infrared waves. This includes people, planets, the Sun, ice cubes and light bulbs. As objects give off infrared waves they cool themselves.

Objects that are black will absorb heat more readily than objects that have a lighter color. Black objects will also cool more quickly than light colored objects. This effect is called “Black Body Radiation”, and will be obvious upon completion of this lab.

Materials Needed:

Materials Needed for Black and Silver Can Lab

1. Two regular soda cans, like one gets from a vending machine.
2. A can of silver spray paint
3. A can of dull black spray paint
4. Thermometers, or temperature probes
5. A bare lamp and an incandescent bulb, at least 60 watt. Compact Fluorescent Lights will **NOT** work well.
6. Graphing paper, straight edges and colored pencils
7. A bar to hang the thermometers from
8. String

Preliminary Preparations:

1. Decide on the number of groups you will have. Groups of two work well.
2. Accumulate two cans for each group
3. Paint ½ of the cans a dull black
4. Paint the other ½ of the cans silver
5. Make sure that each group has two thermometers. One will work, but the experiment takes longer.
6. Make an example graph so that students can see what expectations you may have.

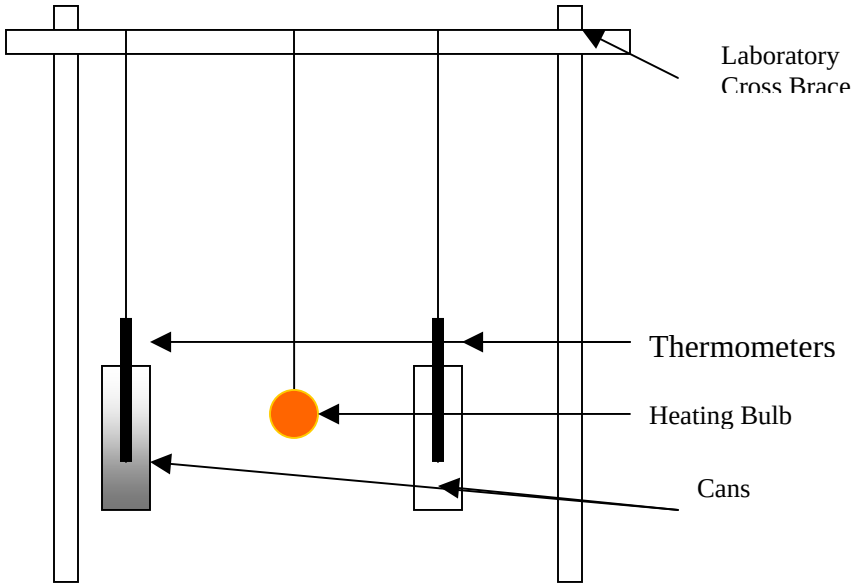
Safety Precautions:

1. The bulb will get very hot, don't let students touch it.
2. Make sure there are no frayed wires or exposed electrical connections.
3. Make sure the paint on the cans is dry, and is not hazardous.

Procedure:

1. Examine the attached diagram.
2. "Dangle" the thermometers into the cans, so that the red bulb is not touching the sides of the can. The thermometers should be in about the same position in each can.
3. Place the heating, incandescent bulb about equal distance from each of the cans. The cans can heat at the same time or one after the other. It does not matter.
4. Take an initial reading when time is zero and **then** turn on the incandescent bulb. Take a reading each 30 second period, without removing the thermometers from the cans, for a total of five minutes.
5. Complete your data chart and compare it with your partner's.
6. Transfer your data to a line graph and complete your post lab questions.
7. As an extension, also keep data for five minutes as the cans cool, and add that to your graph.

Diagram:



Data Chart:

Time	Temperature Black Can	Temperature Silver Can
Zero		
30 sec		
60 sec		
90 sec		
120 sec		
150 sec		
180 sec		
210 sec		
240 sec		
270 sec		
300 sec		

Assessment:

Post-lab Questions for the Black and Silver Can Lab

1. Which color of can absorbed the most radiant energy, and why do you think this is so?

2. What was the average rate of heating for the
   a. Silver can
   b. Black can

3. The air in the cans has thermal energy. Is this potential or kinetic? (circle one)
   a. The light that hit the can was what kind of energy? Radiant or Thermal?
   b. The light bulb is hot, is that Potential or Kinetic Energy?
   c. The electricity in the wires is what? Nuclear or Thermal?
   d. The electricity was made in a power plant that burned coal. Does coal contain Kinetic or Potential Energy?
   e. If the energy in coal was POTENTIAL, would it be Chemical or Stored Mechanical
   f. The coal came from ancient plants that grew in swamps. The plants grew from sunlight, from the Sun. What kind of potential energy does the Sun use to make heat? Nuclear Potential, Stored Mechanical, Chemical.

4. Where does *virtually* all of the energy on the Earth come from?

5. Explain why a person could honestly say that, with the possible exception of nuclear power, it is the energy from the Sun that makes the wall clock run.