Energy Explorations Outline

Station 6

**Thermal Imager Station**

**Materials**

Thermal Imaging Camera LED (60w equiv.)

Safety glasses Incandescent light bulb 60w

Laminated thermal image samples CFL (60w equiv.)

Hand Warmer Three bulb stand

Black Socks

**I. Introductions**

**II. Review of Important Ideas**

**A. Electromagnetic Waves**

* Infrared waves and visible light waves are both forms of electromagnetic radiation. Our eyes respond to visible light waves but not infrared waves.
* Other electromagnetic waves include radio waves, microwaves, ultraviolet, X-rays. Our eyes do not visually respond to these.
* Everything emits infrared radiation. The higher the temperature the more infrared is emitted.

**B. Images or Photographs**

* A visible light image (photo) is a record of visible light waves reflected or emitted by a subject.
* An infrared image (thermal image) is a record of infrared radiation reflected or emitted by a subject which has been made into a visible image. The infrared camera (our thermal imager) converts infrared energy emitted from a surface into the visible spectrum. Hence, it is visible to the human eye.

**C. Uses of Thermal Imaging**

* Briefly mention practical applications of thermal imaging such as:

*Meteorology Military purposes such as detection and targeting*

*Search and Rescue Detection of insulation issues and air leaks*

*Monitor earth/oceans Detection of electrical and other construction problems*

*Astronomy Medical diagnosis and detection*

**III. Activities and Demos**

**A. Regular Photo vs. Thermal Image**

* Show and discuss the laminated photos and thermal images. Explain that the photo is a record of visible light reflected while the thermal image is a record of the infrared radiation or “heat” emitted and reflected.

**B. Thermal Imager / Face**

* Briefly demonstrate how to hold and use the thermal imaging camera
* Use the thermal imager to determine the thermal properties of a face (a member of the student group)
* Discuss how the thermal image is different from what you see in a normal visible light setting
* Discuss: What part of the face is coldest? Hottest? Possible reasons….?

**C. Protective Eyewear**

* Students use the thermal imager to view the same face, now wearing plastic protective eyewear.
* What is observed? Compare how the eyes look with glasses to how they looked with no glasses.

*The thermal energy (infrared radiation) is not able to pass through the thick plastic. The infrared rays are scattered or reflected by the plastic so the eyes do not appear as a higher temperature or “hotter” color. What you see with the thermal imager is the scattered and reflected thermal energy from the room.*

**D. Thermal Handprint**

* Students place their hand on the table for 5-10 seconds then remove the hand and use the thermal imager to scan the table where their hand was. *What do you see using the thermal imager? What happens to the thermal image over time?*
* Thermal energy was transferred from your hand to the table. This causes the table where your hand was to emanate more infrared radiation than the rest of the table. Over time the infrared energy will dissipate and the table will cool, giving off less thermal energy.

**E. Heat Bulb vs. Light Bulb**

* Use the thermal imager to observe all three bulbs at the same time. Notice the temperature differences between the three different types of light bulbs, all 60w or equivalent: IL, CFL, LED. *Which bulb is the hottest, coolest?*
* Note that the majority of the incandescent light bulb’s energy is transferred into thermal energy rather than light energy.
* All three bulbs emit the same amount of visible light (lumens) but the incandescent light bulb emits much of its energy in the infrared (heat) range. This makes it very inefficient.

**F. Black Sock w/ Hand Warmer (Optional, if time)**

* Place two black socks on the table (one with an activated hand warmer). Observe both socks in visible light. (They look the same)
* Observe both socks using the thermal imaging camera. (They look much different)
* Infrared waves have longer wavelengths than visible light waves. This enables the infrared radiation to pass through the socks while visible light waves cannot.

**IV. Closure**

* Fill in leadership guide
* Straighten up, re- set

**Leadership Guide Question:**

A thermal image is a record of the amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an object emits or reflects.

(***Infrared energy or heat energy)***