Energy Explorations Outline

Station 6

**Thermal Imager Station**

**Materials:**

Thermal Imaging Camera LED, CFL, Incandescent Light Bulb

Plastic Glasses 3 Bulb Light Stand

Graphics of Thermal Images & Spectrum Black Socks & Hand Warmer

**Introduction to Thermal Imaging:**

* At this station we will be talking about thermal imaging. Have you heard of the Electromagnetic Spectrum? Did anyone use the microwave for breakfast or listen to the radio on the way to school? *(Pause for answers)* Then you used waves on the Electromagnetic Spectrum.
* *Show Graphic #1.* We are most familiar with visible light. That is the light waves we can see as red, orange, yellow….all the colors of the rainbow. *Point to visible light on the spectrum.* At this station, we’re going to look at infrared or thermal waves. *Point to infrared on the spectrum.*
* Infrared waves and visible light waves are both forms of electromagnetic radiation. Our eyes respond to visible light waves but not infrared waves.
* *Show Graphic #2.* A photograph is a record of visible light waves. *Point to the picture of the man.* Our eyes don’t see infrared waves, but we can capture them with a thermal imaging camera. This picture is the man’s thermal image. *Point to the man’s thermal image.*
* Everything emits infrared radiation. The higher the temperature, the more infrared radiation is emitted. *Point to the thermal image of the earth.* Why is the center of the picture red and the top and bottom blue? *The equator is the hottest part of the world and the two poles are the coldest.*

**Activity #1: Thermal Imaging & You**

*Note to Leaders: Only you should use the thermal camera. Show the students their image after each picture.*

* A thermal image is a picture of the infrared radiation reflected or emitted by a subject which has been made into a visible image. The thermal camera converts infrared energy emitted from a surface into the visible spectrum. That’s why we can see it.
* Image #1-Face
  + Take a thermal image of one of the students in your group and show it to the group. *If they wear glasses, have him/her take them off.* Discuss what part of the face is coldest? Why? *Nose. The air moving through your nostrils is cooler than your body temperature making your nose colder.*
  + Discuss what part of the face is hottest? Why? *Various depending on student. Forehead, neck.*
  + Repeat until you have taken a picture of all the students in your group. *Have some students smile showing teeth/mouth and keep their mouths closed.*
* Image #2-Glasses
  + Repeat the pictures again. This time have the students put their glasses on or wear one of the pairs of plastic glasses.
  + How are your images different with and without the glasses? *The thermal energy 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.*
* Image #3-Handprints
  + Take an image of the table and show the students. You don’t see much of a thermal image.
  + Students place their hand on the table for 10 seconds then remove their hands. Take a thermal image of the table where their hands had been. What does the thermal image show? *Thermal energy transferred from your hands to the table. Over time the energy will dissipate and the table will cool and your thermal handprints will be gone, like the first image.*

**Activity #2: Thermal Imaging & Energy Efficiency**

* Thermal Imaging has many different uses: meteorology, search & rescue, medical diagnosis & detection, and military purposes. The rest of our images will show how thermal imaging can help us make our homes and schools more energy efficient.
* Image #4-Light Bulb vs. Heat Bulb
  + We are going to see how much light and heat energy different light bulbs produce. Does anyone know what types are light bulbs we have? *Take responses and remind students. IL (incandescent), CFL (compact fluorescent), and LED (light emitting diode). Which bulb do you think will be the hottest? The coolest?*
  + *Turn on the three bulb light stand and take an image with all three bulbs in it. It is easiest to do if you take it at an angle.*
  + 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 but the incandescent light bulb emits much of its energy in the infrared (heat) range. This makes it very inefficient.
* Image #5-Black Sock with Hand Warmer
  + *Note to Leaders: When you are setting up your station, open a hand warmer and place it in one of the socks.*
  + Here are two black socks. We are observing them in visible light. Describe them. *They look the same.*
  + Now we’ll take a thermal image of the socks. Both socks must be in the same image. Describe how they are different. *One shows lots of thermal energy.*
  + What’s happening? *Infrared waves have longer wavelengths than visible light waves. This enables the infrared radiation to pass through the socks while visible light waves cannot.*
  + Show Graphic #3. We can use a thermal camera to determine where air might be leaking through the windows and doors, like along the edges where there is blue in pictures.
* Image #6-Images Around the Room
  + If time remains ask students to look around the room. Where might there be air leaking in or out of the room? *Windows, doors, outlets on exterior walls, the corner of the ceiling and exterior walls.*
  + Take thermal images of places in the room and show the students.

**Complete Student Worksheet Question:**

*Note to Leaders: Ask the question to the students. Do not just give them the answer. If incorrect answers are given, talk the students through the correct answer. You may need to refer back to the definition.*

A thermal image is a record of the amount of the **HEAT, THERMAL OR INFRARED ENERGY** an object emits or reflects.