Infrared Light *vs*. Visible Light

Light is an electromagnetic wave, but different frequencies of light interact differently with matter. Humans can detect the narrow range of light, which we call visible light but we don’t see other frequencies such as radio waves, infrared, and ultraviolet. However, since they are all electromagnetic waves, the different spectra of light should have similar behaviors.

All around us we see that some materials are transparent to visible light (like glass) and some materials are opaque (like brick). Also, some objects can make a reflected image in visible light, but other objects can not.

What about infrared? Does infrared light exhibit similar properties as it interacts with common materials?

OBJECTIVES

* Explore properties of light and make comparisons between visible light and infrared light.
* Use the FLIR ONE to explore the properties of infrared light.

MATERIALS

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| iPad®, iPhone®, or iPod® with lightning port | various materials and objects: |
| FLIR ONE™ app | window, mirror, opaque |
| FLIR ONE™ thermal camera for iOS | plastic grocery or trash bag, |
| masking tape | flat metal, clear acrylic |

PROCEDURE

1. Some material, such as a glass window, is transparent to visible light. Use the FLIR ONE to look through a glass window.

Have your partner stand on one side of the window while you use the FLIR ONE on the other side. Using the FLIR ONE app on iOS, take a picture looking through the window. Remember that the FLIR ONE has both a visible and an infrared camera. It might be useful to cover up the visible light camera with a small piece of masking tape so that you can see the pure infrared image.

2. Some material is opaque to visible light.  One example is a plastic bag. Have your partner hold the grocery bag. Use the FLIR ONE to look at your partner through the bag.

3. When you look at a mirror, you can see a visible light image from some object. Use the FLIR ONE to look at a mirror.  Record your observations.

4. Although light reflects off a flat surface like a white board, it does not form a visible image. Use the FLIR ONE to look at a flat surface such as a whiteboard or a tiled wall.

5. Use the FLIR ONE to explore other objects and materials. Try to find another material that is transparent to visible light but opaque to infrared light.

6. Use the FLIR ONE to find another object that is opaque to visible light, but transparent to infrared light.

7. Use the FLIR ONE to find another object that creates a reflected image in infrared light.

ANALYSIS Questions

1. If a material is transparent to visible light, is it also always transparent to infrared light? Give an example.

2. Are there any materials that are transparent to both infrared light and visible light? Give examples.

3. Describe an object that you found that was opaque to visible light, but transparent to infrared light.

4. Suppose you wanted to build a telescope that used the infrared portion of the electromagnetic spectrum. Could you use a glass lens? Why or why not?

5. You should be able to find several objects that create a reflected image in infrared. What do all of these objects have in common? Do they also create an image in visible light?

6. Considering that a window is highly reflective in the infrared range, what problems will this introduce when trying to measure the temperature of glass?

Extensions

1. When visible light passes through glass there can be refraction such that the light waves bend both when entering and leaving the material. Does the same happen for infrared entering a transparent material? Create an experiment to test the index of refraction for infrared.

2. With visible light, you can create a magnified image with a glass lens or with a curved mirror. Could you also make a magnified infrared image with some type of curved surface? What material would you use and what would this object look like?

3. Inspect the FLIR ONE camera. Which is the infrared camera and which is the visible light camera? How do you know?