

SEEING THE INVISIBLE

INFRARED LIGHT DETECTORS IN OUR DAILY LIFE

MATERIALS: smartphone camera or digital camera, TV remote control

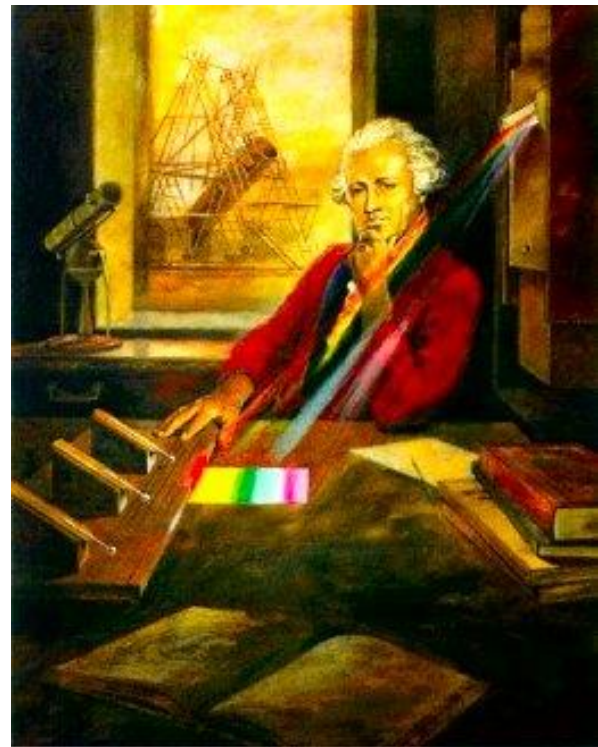
Background Information: Have you ever wondered how remote controls work? They send signals in a special type of light called "Infrared Light." Human eyes cannot detect infrared (IR) light, but smartphone and digital cameras can.

Infrared light was discovered accidentally in 1800 by British scientist, Sir Frederick William Herschel. In what is now famously known as the Herschel Experiment, he attempted to measure how different colors of light change the temperature of a thermometer by passing sunlight through a prism. He placed one of his thermometers outside the red part of the visible spectrum, where no light appeared to be falling as a control unit. He expected the control thermometer to stay unchanged. To his surprise, the control thermometer got hotter than all the rest! He called this invisible radiation "calorific rays." Today, it is known as infrared light.

To Do:

Your smartphone or digital camera takes pictures and videos electronically. They have imaging chips that detect both visible and some wavelengths of IR light.

- Take a TV remote control that you know works.
- Look at the end of the remote control that you point toward the TV and press any button. Hold the button down. Can you see any light coming from the end of the remote control?
- Now, do the same thing, holding down any button on the remote control, but view the remote control through your smartphone or digital camera.*
- What did you see? If you see the blinking light from your remote control, you have just used an infrared detector to "see" invisible light!



Sir Frederick William Herschel and his famous IR light experiment. Courtesy NASA

*Hints: With smartphones, switch to the screen side camera if the other camera does not detect IR. Some digital cameras do not detect IR because they include a filter that blocks IR.

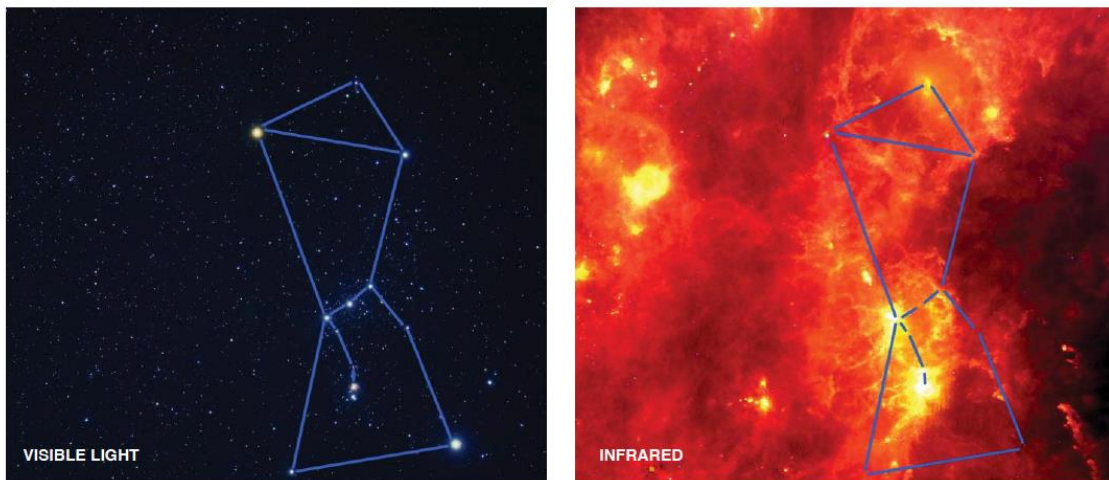
Taking it further:

Does IR light pass through the same materials as visible light? Use your smartphone or digital camera to experiment. Try paper, cellophane, plastic bags of various types, hard plastic, and glass. Does IR pass through sunglasses or regular eye glasses?

Space Science and SOFIA connection: Astronomers understand the universe by observing it in many types of light. Infrared light is important in understanding planets, stars, and galaxies because in IR light we can see things that are warm, but not hot enough to shine like stars. Most IR light is filtered out by water vapor in our atmosphere. So, scientists launch IR telescopes into space or use IR telescopes in high-altitude airplanes or balloons. They also use large ground-based telescopes on top of tall mountains, such as the Infrared Telescope Facility (or IRTF) in Hawaii at 14,000 feet elevation, which can see part of the IR spectrum.

NASA currently operates the world’s largest flying observatory: SOFIA (Stratospheric Observatory For Infrared Astronomy). SOFIA is an extensively modified Boeing 747 carrying a 2.5 meters (100 inches) reflecting telescope, flying up to 45,000 ft., and capable of making observations that are impossible for even the largest and highest ground-based telescopes. For more information on SOFIA science and operations, go to:

www.sofia.usra.edu



These views of the constellation Orion dramatically illustrate the difference between the familiar, visible-light view and the richness of the universe that is invisible to our eyes, though accessible in other parts of the electromagnetic spectrum.