Stratospheric Observatory for Infrared Astronomy
SOFIA

Active Astronomy: Classroom Activities for Learning About Infrared Light

"What's Getting Through to You" Section 2 Images

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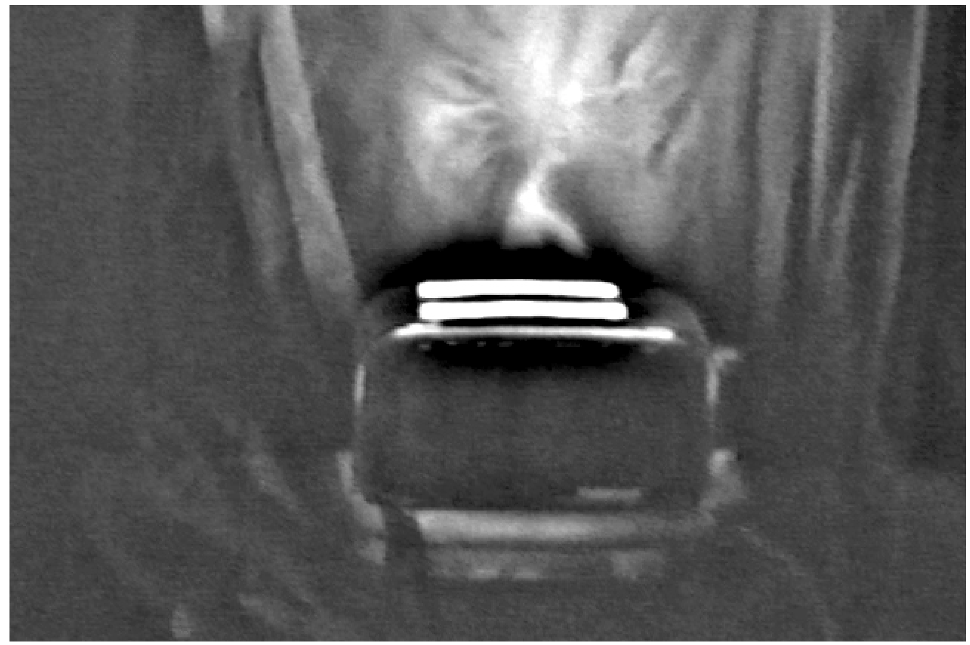
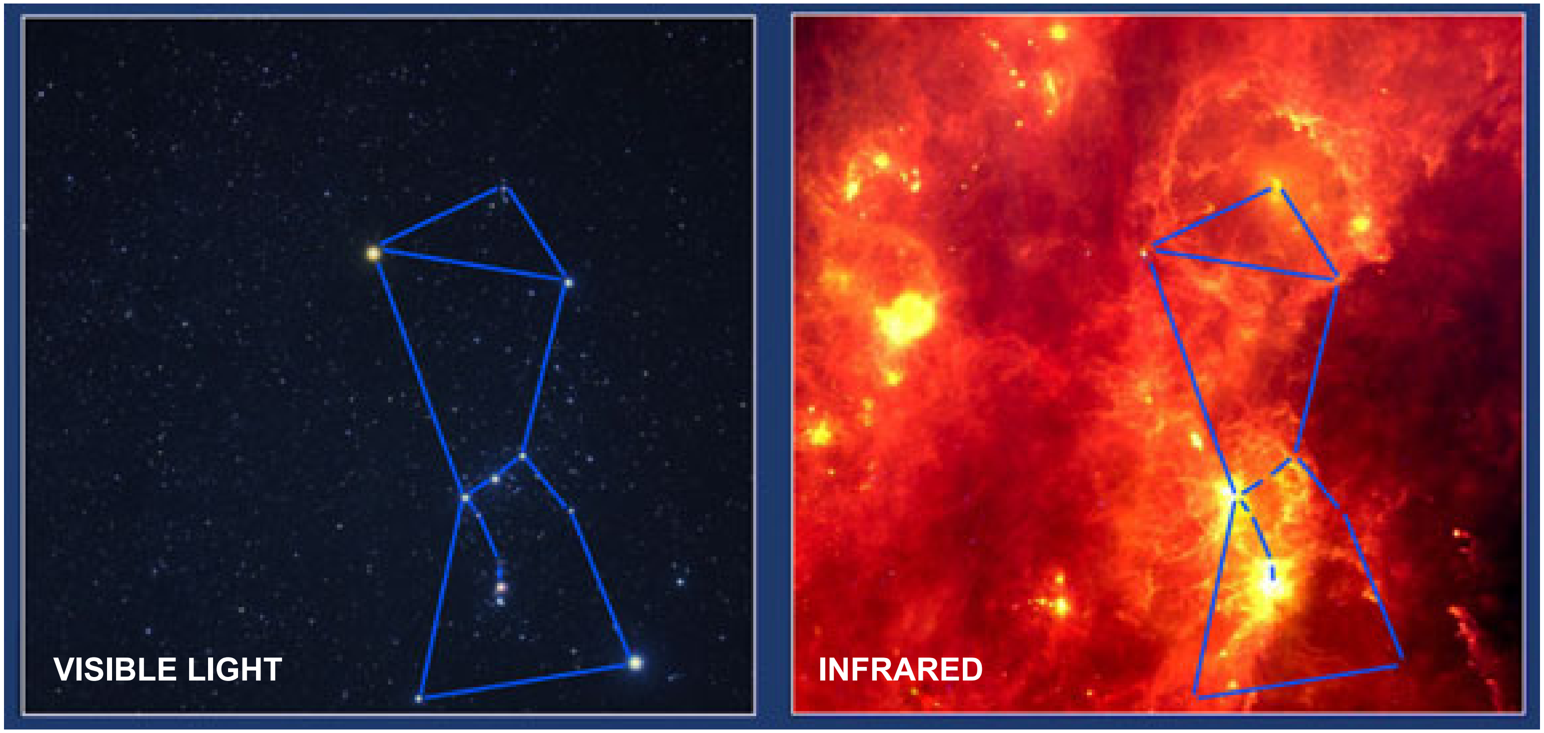
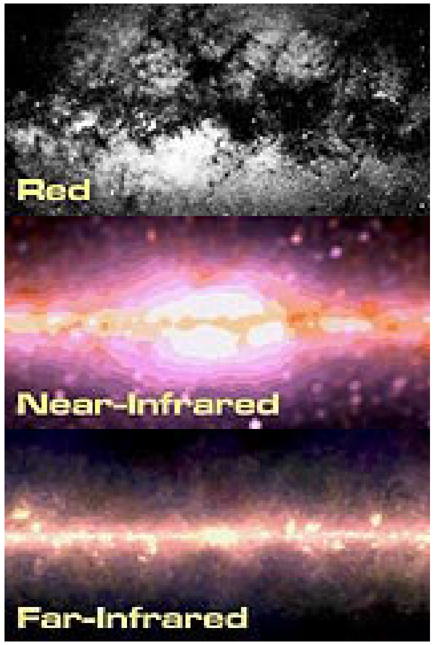
Visible Light View of a Hot Toaster

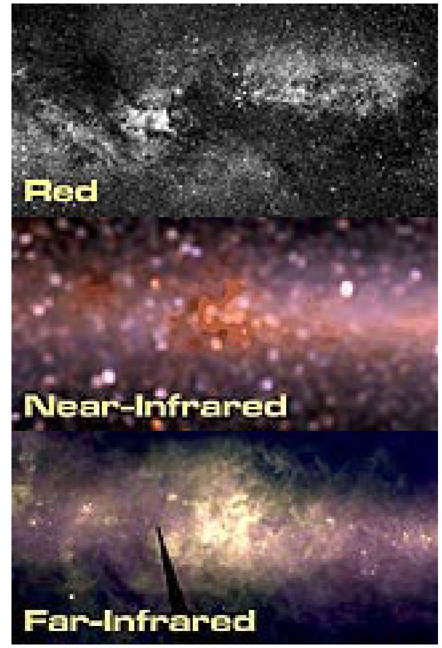


IR Light View of a Hot Toaster



SIRTF - INFRARED PROCESSING AND ANALYSIS CENTER

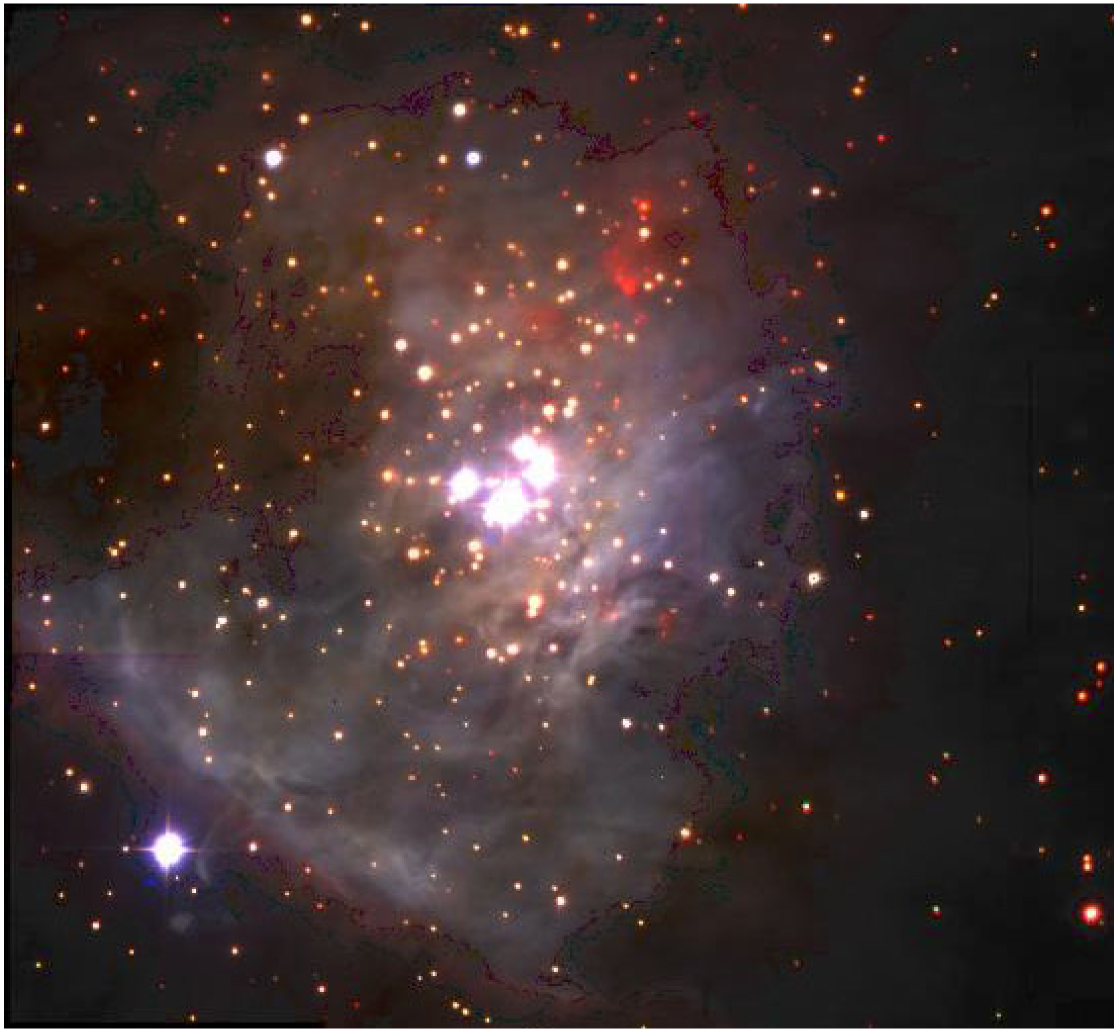




The Galactic Center (left) and the Cygnus Region (right)

In space, there are many regions which are hidden from optical telescopes because they are embedded in dense regions of gas and dust. However, infrared radiation, having wavelengths which are much longer than visible light, can pass through dusty regions of space without being scattered. This means that we can study objects hidden by gas and dust in the infrared, which we cannot see in visible light, such as the center of our galaxy and regions of newly forming stars.

The images above, of the central region of our own Milky Way Galaxy and of the Cygnus star-forming region, show how areas which cannot be seen in visible light can show up very brightly in the infrared. The top row shows these regions in visible red light. At this wavelength we are seeing the light from billions of stars, particularly the largest, brightest ones. Note the dark bands where vast clouds of dust block our view of more distant objects. The middle row shows the same regions in the near infrared (infrared wavelengths closest to visible light). Here the light we see is also generated by stars, but now it better traces the smaller, cooler ones. Notice how the the lanes of dust have become partially transparent, allowing us to see things that are hidden in visible light. Our view of the central bulge of stars in our own Milky Way galaxy is particularly striking since it is almost completely obscured at shorter wavelengths! The bottom images show these regions in the far infrared (infrared wavelengths farther from visible light). At these wavelengths, stars hardly emit any light at all. Instead almost everything we see is generated by the dust clouds themselves. The dust, which is colder than the coldest arctic night on earth, is still warm enough to emit the thermal infrared radiation seen here.

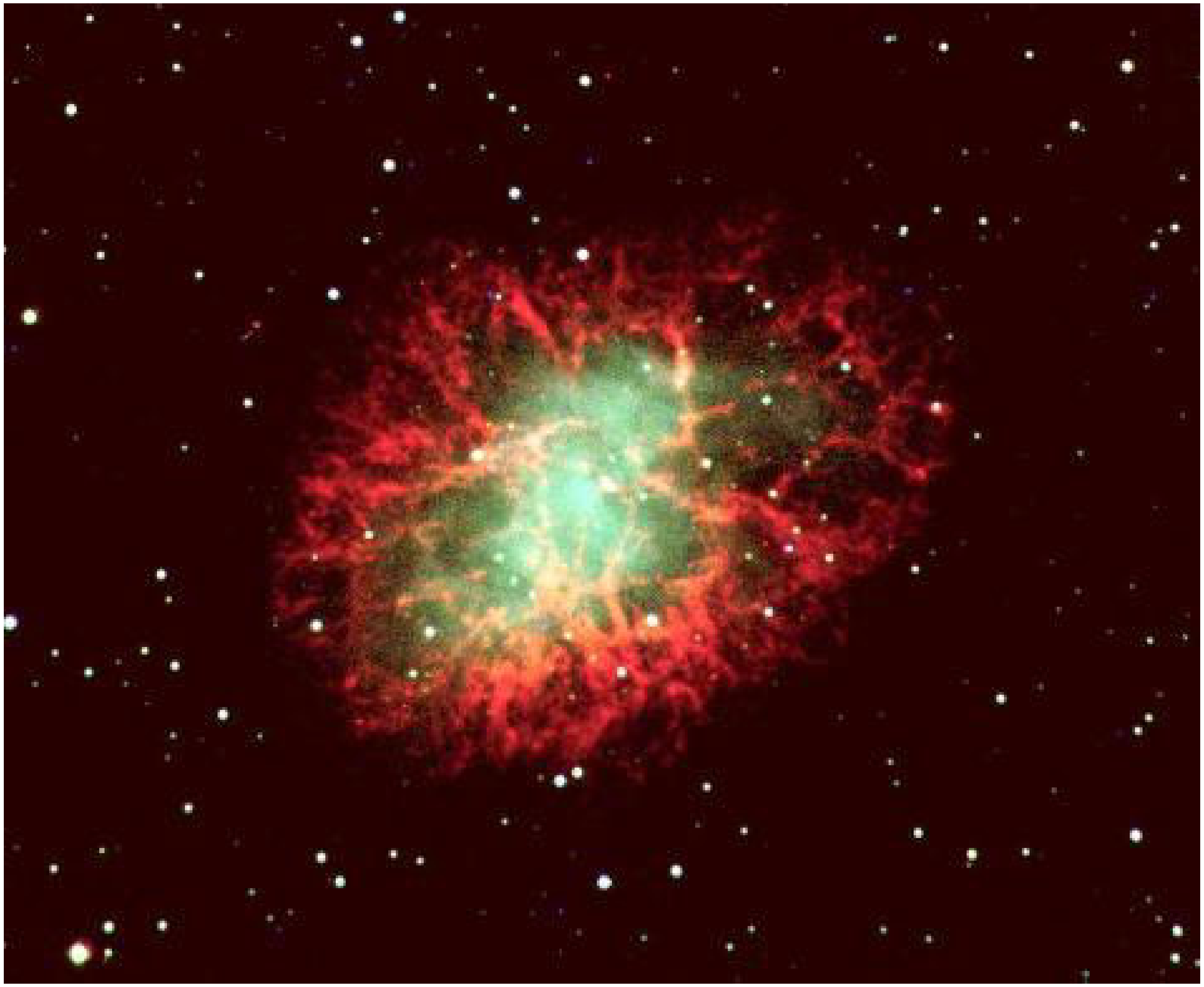


Credits: Philip Lucas (Univ. Hertfordshire) and Patrick Roche (Univ. Oxford), UKIRT

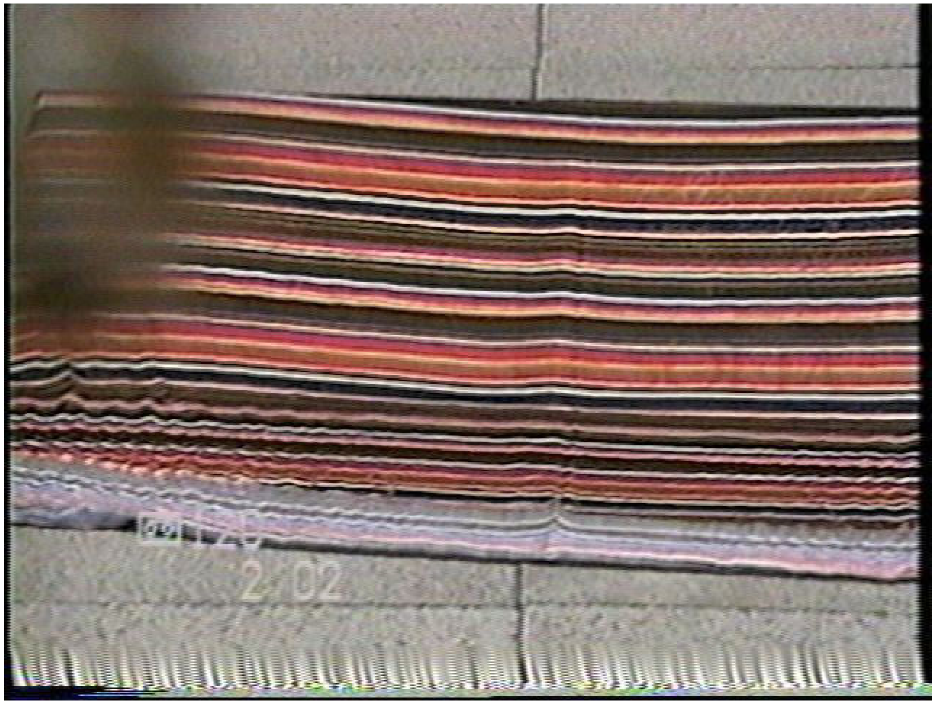
Many objects in the universe which are much too cool and faint to be detected in visible light, can be detected in the infrared. These include cool stars, infrared galaxies, clouds of particles around stars, nebulae, interstellar molecules, brown dwarfs and planets. For example, the visible light from a planet is hidden by the brightness of the star that it orbits. In the infrared, where planets have their peak brightness, the brightness of the star is reduced, making it possible to detect a planet in the infrared. Some of the most exciting discoveries in infrared astronomy have been the detection of disks of material and possible planets around other stars. Recently, an infrared survey of the Trapezium star cluster in the Orion Nebula revealed over 100 low mass objects which are brown dwarf candidates. See http://antwrp.gsfc.nasa.gov/apod/ap000331.html for details.

Image credit: R.I. Thompson (U. Arizona), NICMOS, HST, NASA).

In the infrared, astronomers can gather information about the universe as it was a very long time ago and study the early evolution of galaxies. As a result of the Big Bang (the tremendous explosion which marked the beginning of our Universe), the universe is expanding and most of the galaxies within it are moving away from each other. Astronomers have discovered that all distant galaxies are moving away from us and that the farther away they are, the faster they are moving. This recession of galaxies away from us has an interesting effect on the light emitted from these galaxies. When an object is moving away from us, the light that it emits is "redshifted". This means that the wavelengths get longer and thereby shifted towards the red part of the spectrum. This effect, called the Doppler effect, is similar to what happens to sound waves emitted from a moving object. For example, if you are standing next to a railroad track and a train passes you while blowing its horn, you will hear the sound change from a higher to a lower frequency as the train passes you by. As a result of this Doppler effect, at large redshifts, all of the ultraviolet and much of the visible light from distant sources is shifted into the infrared part of the spectrum by the time it reaches our telescopes. This means that the only way to study this light is in the infrared. Infrared astronomy will provide a great deal of information on how and when the universe was formed and on what the early universe was like. The image above is an infrared view of some of the farthest galaxies ever seen.



This image was obtained by Sven Kohle and Till Credner of Bonn, Germany on October 26, 1995. The image is copyrighted by the observers. It may be used for private and non-profit educational purpose if the authorship and copyright is acknowledged.



Visible Light Image of Fabric Covering Two Logos

Infrared Image of the Same Thing