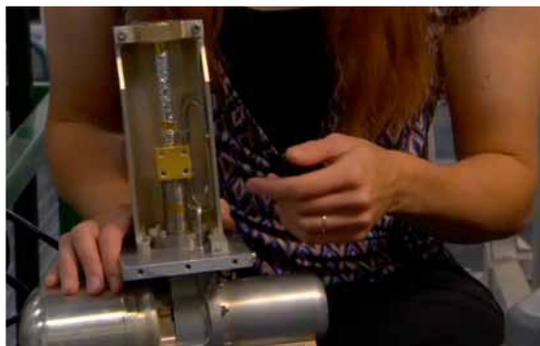




# Chill Out Tiny Refrigerator Saves Hubble Camera



Albuquerque, NM (Kirtland Air Force Base)—The Hubble captures views of galaxies we never knew existed. Scientists develop a cryocooler to remedy a malfunction in the Hubble Telescope’s infrared sensor system. During the malfunction, liquid nitrogen in the sensing dewar boiled off and became depleted. The new system does not need the liquid nitrogen.

*“A cryocooler is a mechanical device that allows us to cool to cryogenic temperatures.”* Erin Pettyjohn, physicist

## Framework

Middle School

## Standards

- NSES - B.iii.5 ➤ Energy in the form of heat and light are transferred into or out of a system.
- STL - 2.Q ➤ Malfunctions affect the quality of the system.
- STL - 10.Q ➤ Invention and innovation play a role.
- STL - 17.H ➤ Information and communication systems allow transfer of information.

## Content Illustrated

- Astronomical entities viewed with the Hubble Telescope.



# Content



## Physical Science

- Cryogenics is a field that looks at what happens at temperatures below  $-150^{\circ}$  Celsius.
- When gas expands in the cryocooler, it cools down the sensor.

## Earth & Space Science

- Pictures from the Hubble help us understand our solar system and the nature of the universe. We are gaining knowledge about galaxies.
- Space is very cold. The sensor must be even colder to pick up readings from stars.
- Space is not empty. There is debris in space.

## Technology

- The infrared sensor needs to be very cold in order to function. Cryocoolers can cool things down to 70 degrees Kelvin ( $-334^{\circ}$ F). A cryocooler uses helium gas, compressors, and pumps to cool the sensor mounted on it.

## Engineering

- Scientists design, test, and improve devices such as the cryocooler, which are operating in space.

## Math

- Temperature unit (Celsius, Fahrenheit) conversions. Non-negative scale (Kelvin).

## Guiding Questions

*To think about as you watch:*

- What is infrared light? Where is it on the electromagnetic spectrum?
- How does this technology change our view of the solar system?

## Suggested Activities

- Find out what other devices or technologies use infrared sensors.
- Research the history of the Hubble Telescope and Dr. Edwin Hubble.
- Create a slideshow of pictures from the Hubble Telescope.

## Keywords

absolute zero  
astronomy  
cryocooler  
cryogenics  
Celsius  
dewar  
Fahrenheit  
galaxy  
Hubble Telescope  
infrared sensor  
infrared radiation  
Kelvin  
NICMOS

- *Chill Out* can be found online at [www.ndep.us/Chill-Out](http://www.ndep.us/Chill-Out). Visit [www.ndep.us/LabTV](http://www.ndep.us/LabTV) for a list of process skills modeled in webisodes.