National Aeronautics and Space Administration

Guide Lites

Rose Colored Glasses

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Rose-Colored Glasses

Since its launch in 1990, the powerful gaze of the Hubble Space Telescope, or HST, has brought some of the mysteries of the universe into focus. Far above Earth's surface, HST floats clear of Earth's light-distorting atmosphere, beaming back images that have transfixed humanity, changed the scientific world, and captured details of the universe that are impossible for land-based telescopes to detect.

HST's triumphs have continued to accumulate thanks to a unique design that has allowed astronauts to repair and upgrade the telescope while it remained in orbit. The Wide Field Camera 3, or WFC3, was installed on HST during its last servicing mission in May 2009. This camera extends HST's view, allowing it to peer further into the mysteries of the cosmos.

Light is a form of energy that travels in waves. The human eye can see only a small section of this electromagnetic energy. This section is called visible light. Longer wavelengths within the visible light spectrum look red while shorter wavelengths in this range look violet. Special lenses in the Wide Field Camera 3 separate light into different wavelengths, enabling HST to span the electromagnetic spectrum from the near ultraviolet through the visible light range, and into the near infrared. The Hubble Space Telescope's new camera looks deeper into the universe, helping scientists capture images never before seen while expanding our knowledge of the universe.

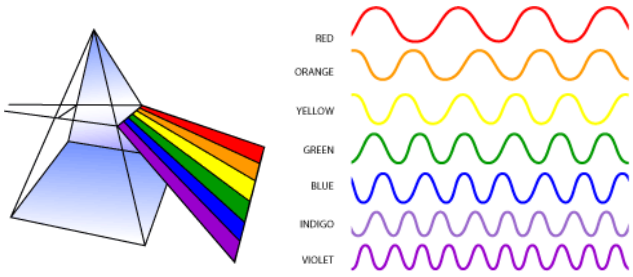

Image credit: NASA

Objective:
In this activity participants use colored filters to learn more about the electromagnetic spectrum to understand how the new camera on the Hubble Space Telescope helps scientist explore the universe.

Materials:
- five paper towel tubes
- five pieces of colored cellophane to cover the end of the paper towel tube
  - one of each color: red, yellow, green, blue, and violet
- five rubber bands
- Hubble images, downloaded from http://hubblesite.org/gallery/

Engage:
Preparation: Print color pictures from the Hubble image gallery onto photo paper or project images onto a wall or screen. Cover the end of each paper towel tube with one piece of colored cellophane.

Ask participants to look at the Hubble image through one of the paper towel tubes, holding the tube so the colored film is away from the eye. Then direct participants to change tubes and look at the image with a

different colored lens. Do the images appear different? Ask participants to try each color and determine which colored lens allows the viewer to see the clearest /crispest details in the image and which lens gives the least clear image. *(The majority of viewers will choose red for the least clear and violet for the clearest image.)*

Ask participants why they think the colors make the images appear different. Relate participant's responses to the wavelengths of visible light in the electromagnetic spectrum. Long wavelengths have less energy. Although effective at detecting heat energy, red to near infrared lenses are not effective for viewing crisp images. Short wavelengths with more energy allow the viewer to see distinct details. Violet lenses accentuate individual pixels, clearly defining images. Explain that the new camera on the Hubble Space Telescope uses expanded lenses in the near infrared and near ultraviolet range to extend scientists' abilities to capture images of faraway galaxies in the universe.

Explain:
To learn more about the Hubble re-servicing mission and the new camera on the Hubble Space Telescope, watch the NASA eClips™ video segment, *Real World: Hubble Wide-Field Camera 3,* which can be viewed or downloaded at: www.nasa.gov/education/nasaeclips.
This segment can be viewed in high definition using the following direct link to YouTube/NASA eClips™: http://www.youtube.com/watch?v=Vwc8qPuvH-c&feature=PlayList&p=887C1C3BAAD53F17 .

To learn more about the history of the Hubble Space Telescope, watch the NASA eClips™ video segment, *Our World: Hubble History*, which can be viewed or downloaded at: www.nasa.gov/education/nasaeclips.
This segment can be viewed in high definition using the following direct link to YouTube/NASA eClips™: http://www.youtube.com/watch?v=tFC403WByiA&feature=PlayList&p=31002AD70975DC1B .

Extend:
To learn more about the effect of the atmosphere on Earth-based telescopes, watch the NASA eClips™ video segment, *Launchpad: Atmosphere and Optical Telescopes*, which can be viewed or downloaded at: www.nasa.gov/education/nasaeclips.
This segment can be viewed in high definition at the following direct link to YouTube/NASA eClips™: http://www.youtube.com/watch?v=0j_Dzxqhs6k&feature=PlayList&p=D7BEC5371B22BDD9.

To learn more about other types of telescopes, watch the NASA eClips™ video segment, *Our World: Arecibo – The Largest Radio Telescope on Earth*, which can be viewed or downloaded at: www.nasa.gov/education/nasaeclips
This segment can be viewed in high definition at the following direct link to YouTube/NASA eClips™: http://www.youtube.com/watch?v=Y8ESZ-dQUbc&feature=PlayList&p=31002AD70975DC1B .

To learn more about x-ray telescopes, watch the NASA eClips™ video segment, *Our World: Chandra – Exploring the Invisible Universe*, which can be viewed or downloaded at: www.nasa.gov/education/nasaeclips
This segment can be viewed in high definition at the following direct link to YouTube/NASA eClips™: http://www.youtube.com/watch?v=kHJRpOUH_7s&feature=PlayList&p=31002AD70975DC1B .