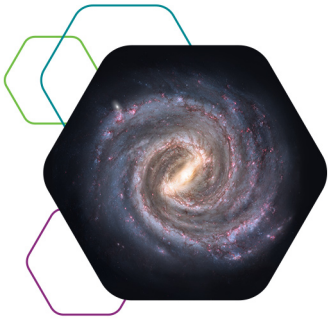

FACILITATOR GUIDE

Filtered Light

Learning objectives

- Astronomers use light from distant objects to make observations about the universe.
- Filters block certain energy levels of light while allowing others to pass through.
- NASA scientists use telescopes and other instruments to capture and filter different energies of light.

Materials

- Blue filters in cardboard holders
- Red filters in cardboard holders
- Pink and blue highlighters (Sharpie™ brand)
- Red and blue grease pencils (wax writing tools)
- White paper
- Black paper
- Space images
- Activity and facilitator guides
- Information sheets
- *Tips for Leading Hands-on Activities*

The Explore Science toolkit comes complete with all necessary materials for this activity. Materials are also readily available to create or restock activity kits. The red and blue Roscolux™ brand lighting gels work well as filters in this activity. To purchase or replace the filters, look for #80 Primary Blue and #26 Light Red. Graphic files can be downloaded from www.nisenet.org.

Notes to the presenter

The pink and blue circles on the white paper should mostly seem to disappear when covered by the red and blue filters because the colors of the circles are blending in with the same wavelengths of light reflecting off the white paper. On the black paper, the red pencil should actually appear to be enhanced by the red filter, and the blue pencil by the blue filter, because all the other wavelengths of light are blocked by the filter.

Because the word “light” has been used to describe light that our eyes can see (visible light), some scientists do not feel that it is accurate to use “light” for electromagnetic waves outside of the visible part of the spectrum. However, it can be useful to describe the rest of the electromagnetic spectrum in terms of light, or “light energy,” because it is a concept the public has experience with, so we use this term throughout this activity and related resources.

In addition to filters (filter wheels) many NASA telescopes use spectrometers and other instruments for breaking up and analyzing light.

Visitors love drawing their own pictures and exploring them with the filters. In fact, once they've started doing this they may not want to stop! If you find it difficult to bring this activity to an end, you might suggest that the participant add "one last piece" to their drawing, and then let someone else have a turn.

Young children, especially, may prefer to create a picture more elaborate than a simple circle even in the first step. After some drawing time, model how to look through the filters, and encourage the children to describe what they see by asking open-ended questions such as, "What changes when you look at your drawing through the red filter?" As appropriate, introduce the space images for viewing through the filters, but also allow children to focus on their own drawings if that is where they show the most interest.

Conversational prompts

You may find yourself with plenty of time to chat while the visitors draw and color. Try prompting some of these conversations:

- "Many types of light are invisible to our eyes. Can you think of anything from your life that's invisible? Tell me about it. Do you think it might produce light we can't see?"
- "Filtering light helps scientists focus on just one thing at a time when they are studying planets, galaxies, and other things in space. How do you help yourself focus on one thing? Do you have any tricks or tools that you use? (e.g., turning off the TV to do homework, meditation, counting sheep to fall asleep)"

Difficult concepts

Objects in space emit light from the full *electromagnetic spectrum*—not just the colors we can see with our eyes (visible light). Often, images of space include types of light outside the visible, such as X-ray, infrared, and ultraviolet light, that have been translated into visible colors by researchers so that we can see them and to make the images more useful. The real space images in this activity are good examples of this. Many of the colors that we see in these images represent other wavelengths of light. These representational-color images help scientists highlight and pay attention to certain features. We all need ways to focus! In this activity, we're exploring just the visible wavelengths of light with the filters and craft supplies because we can do this without specialized tools.

One way to talk about light is by wavelength, but another way to describe it is by its energy. Visible light ranges from red to blue (or purple/violet) and red light has lower energy than blue light. Given that hot water is often indicated with red writing and cold water is often indicated with blue writing, you might expect red light to have more energy than blue light. However, the opposite is true! Bluer stars are hotter than redder stars.

Staff training resources

Refer to the *Tips for Leading Hands-on Activities* sheet in your activity materials.

- An activity training video is available at vimeo.com/245834788
- A content training video is available at vimeo.com/245835335
- The NISE Network has a curated list of programs, media, and professional development resources in the NASA Wavelength Digital Library that directly relate to the toolkit. These resources can be viewed and downloaded from nasawavelength.org/users/nisenet.

Credits and rights

This is a classic activity and was adapted from several sources including the educator guide, Rose-Colored Glasses, developed by NASA eClips. Retrieved from: https://solarsystem.nasa.gov/moon/docs/Rose_Colored_Glasses_Guide_Lites.pdf

Visible vs infrared light courtesy ESO / M. Kornmesser.

Image of NGC604 courtesy X-ray: NASA/CXC/CfA/R. Tuellmann et al.; Optical: NASA/AURA/STScI.

Image of Phoenix Glalaxy Cluster courtesy X-ray: NASA/CXC/MIT/M.McDonald et al; Optical: NASA/STScI; Radio: TIFR/GMRT.

Image of NGC 2818 courtesy NASA, ESA, and the Hubble Heritage Team (STScI/AURA).

Image of Hubble Space Telescope courtesy NASA's Goddard Space Flight Center.

Image of NGC 1512 courtesy NASA, ESA, and D. Maoz (Tel-Aviv University and Columbia University).

Electromagnetic spectrum graphic courtesy High Energy Astrophysics Science Archive Research Center (HEASARC) at NASA's Goddard Space Flight Center.

Pencil in infrared graphic courtesy NASA/ JPL-Caltech.

Image of *red, green, and blue light mixing* courtesy licensed under Creative Commons Attribution-Share Alike 3.0 Unported http://en.wikipedia.org/wiki/Image:RGB_illumination.jpg

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