



# LUNAR AND PLANETARY INSTITUTE STEREO IMAGERY: ANAGLYPHS

## OBJECTIVES

- Students will be introduced to anaglyphic (red/blue) 3-D images
- Students will make their own red/blue 3-D glasses for viewing anaglyphs

## STANDARDS

### *Science as Inquiry*

- Develop an understanding of scientific inquiry

### *Science and Technology*

- Develop an understanding of science and technology

### *History and Nature of Science*

- Develop an understanding of the nature of science
- Develop an understanding of the history of science

## ABOUT THIS LESSON

Anaglyph or red/blue (or green) images are the most common form of 3-D images. These are the kind that require red/blue (or green) glasses to view them. When viewed without the glasses they look misregistered. The 3-D images on this CD-ROM are anaglyphs. In this lesson, students will be introduced to different types of anaglyphs, their history, and how to make their own 3-D glasses to view them.

## MATERIALS

- Oaktag in different colors, colored markers, pencils, scissors, clear tape, basic pattern for glasses (included)
- Sheets of red and blue acetate (available at art supply stores)
- Historical and space-related anaglyphic images (see Resources)

## TIMEFRAME

45 minutes: 10 minutes for introductory discussion, 20 minutes to make the glasses, and 15 minutes for viewing anaglyphs.

## **BACKGROUND INFORMATION**

### ***What is an anaglyph?***

Anaglyphic stereograms (anaglyphs) are stereo pairs of images in which each image is shown using a different color. The two images are overlapped and then viewed using red/blue or red/green glasses (depending on the colors used). This means that the color channel is used for the stereo separation and therefore the perception of anaglyphs is monochrome (black and white), although color anaglyphs can be made.

The word **anaglyph** comes from the Greek **anaglyphos**, meaning “wrought in low relief”; this comes from the word **anaglyphēin**, which means “to carve in relief” (ana = up + gluphein = to carve).

### ***Who invented the anaglyph?***

The discovery of anaglyphic 3-D came in the 1850s as the result of experiments by the Frenchmen Joseph D’Almeida and Louis Du Hauron. In 1858 D’Almeida projected 3-D magic lantern slide shows in which color separation took place using red and blue filters, and the audience wore red and blue goggles. Louis Du Hauron created the first printed anaglyphs using early color printing and photography techniques.

William Friese-Green created the first 3-D anaglyphic motion pictures in 1889, using a camera with two lenses, which were first shown to the public in 1893. Anaglyphic films called “plasticons” or “plastigrams” enjoyed great popularity in the 1920s. These used a single film with the green image emulsion on one side of the film and the red image emulsion on the other. In 1922, an interactive plasticon, entitled “Movies of the Future,” opened at the Rivoli Theater in New York. The film provided the viewer with an optional ending. The happy ending was viewed using the green filter, while the tragic ending could be seen using the red filter. Many science fiction films of the 1950s were in anaglyphic 3-D and have been shown on television (although today they are often shown in theaters using polarized 3-D).

Anaglyphic images have been used in comic books, newspapers, and magazine ads. In 1953, 3-D comic books were invented and distributed with red/green “space goggles.” Three- and four-color anaglyphic images are in use today in comic books and by some advertisers, but most often images are two-color.

### ***How do we use anaglyphs today in science?***

Anaglyphic space imagery like that on the CD-ROM is used by scientists to map the topography and geology of the planets and moons. Stereo images can reveal geologic features of the planet not otherwise visible. Just as the early stereogram images allowed people around the world to experience different places and events, stereo images of the planets help us to experience these different worlds in a more tangible way.

Scientists at the Jet Propulsion Laboratory used anaglyphic images to look at the surface of Mars using pictures sent back by the Pathfinder spacecraft. This allowed the scientists to experience the planet in a more “real” or familiar way. The features of the surface and the rocks could be analyzed in more detail using these images. The Viking spacecraft that visited Mars in the 1970s also returned some images in stereo, as did the Apollo missions to the Moon in the 1960s and 1970s.

### ***What about colorblindness and anaglyphs?***

Students who have colorblindness will **not** have major problems viewing red/green or red/blue anaglyphs. One out of every 20 white males has some form of red/green colorblindness, and about 1 in 1000 people of all sexes and races are completely colorblind. In anaglyphs, the color is important only as a way of having one or the other image pass the filter in front of the respective eyes. It is not important that one then be able to distinguish the color of each image.

In fact, normally sighted people often suffer from “color bombardment” when viewing anaglyphs because their brain revolts at seeing the same object as being different colors with each eye. A red-green colorblind person sees both colors as gray and therefore is not bothered by this effect. Red-green colorblind people do sometimes have difficulties with red-green anaglyphs since although the colors appear similar, the intensities are rather different — the red image typically looks darker than the green.

### ***How do the red/blue glasses work?***

When you look through the red lens, only red light is allowed through. The eye that is covered with the red lens will see the red image. By the same token, the blue lens only allows blue light through, so the eye that is covered with the blue lens will see the blue image. In an anaglyph, when a given color filter stops the other colors, it is called **subtractive filtration**. Because the red and blue images are slightly offset, each eye sees a slightly different view of the picture. This disparity simulates the distance between our two eyes, which provides two views of the same scene, therefore providing us with the perception of depth, or **binocular stereopsis**.

## **VOCABULARY**

- anaglyphs
- anaglyphic
- binocular stereopsis
- disparity
- monochrome
- subtractive filtration

## **PREPARATION**

Make sure each student has a piece of oaktag, a pair of scissors, a copy of the basic pattern for tracing, and a pencil. Each group should have a set of colored markers, clear tape, and some red and blue acetate. The acetate can be cut into small pieces beforehand.

If you have a computer hooked up to the Internet you can have a station set up at one of the 3-D Web sites (for example, the 3-D Tour of the Solar System Web site at [http://cass.jsc.nasa.gov/research/stereo\\_atlas/SS3D.HTM](http://cass.jsc.nasa.gov/research/stereo_atlas/SS3D.HTM), or other sites mentioned under Resources). You can print out in color some of the sample anaglyphs that are available on the CD-ROM (you may want to laminate them). You can also find Mars surface anaglyphs in past issues of *Astronomy* and *National Geographic*.

# IN-CLASS ACTIVITY: MAKING 3-D GLASSES

## INTRODUCTION AND DISCUSSION

Have the students look at the red/blue anaglyphs you have printed out, or one of the Web sites at a computer station. They will look like misregistered photographs. Ask the following questions:

### **What kind of photographs are these? Why do they look misregistered?**

Some students will know what they are and be able to tell you that you need special glasses to see them.

### **What kind of special glasses do you need?**

Explain the process by which the red/blue glasses work. Pass around the color chart. Have them hold up the red gel and look at something with red in it (the red will seem to disappear).

### **How do the images combine to create 3-D?**

Explain that they give each eye a separate image because the colored lenses filter the corresponding color. This subtractive filtration fools your visual system and binocular stereopsis is achieved.

## MAKING 3-D GLASSES

Make sure each student has a copy of the necessary supplies and a copy of the pattern. First, have them cut out the sample pattern and eyeholes, then tape the sides to the center section. They can use this as the basis for their own design. **Encourage them to be creative!** Have them lay the pattern on the oaktag and cut out their glasses. They can vary the outer shape if they choose.

After they are finished designing and cutting out their glasses, have them tape the red (left) and blue (right) acetate pieces to cover the eyeholes. Make sure they cut the acetate pieces a little larger than the opening for their eyes. They should not get tape on the part of the acetate they are looking through. They can decorate the glasses using various art supplies on hand. Finally, have them put their names on their glasses. **Don't forget to take a picture of your class wearing their glasses!**

## VIEWING ANAGLYPHS

Using the red/blue glasses, have the students view the anaglyphic images.

Have the students reverse the glasses (put them on backwards).

### **What happens?**

When you reverse the glasses, the depth perception is also reversed. In other words, the parts of the image that originally appeared to be coming toward you now appear to be heading away from you.

Next have them look at the images using the blue lens ONLY.

### **What happens? Why?**

The red letters seem to disappear because the color red is filtered out by the blue lens.

If they have done the previous lessons, have them compare this experience with viewing 3-D images with the stereoscope and View-Master.

### **What are some of the differences? Which ones did you like better?**

**Does the lack of color in the anaglyphs impair your viewing experience?**

## EXTENSIONS

Take pictures of your class wearing their glasses!

Research different kinds of anaglyphs on the Internet. Some good sources are given in the Resources section. These include geodesic, animated, NASA, and antique images.

Create anaglyph drawings on the computer using a graphics program. Color a line drawing blue. Copy it and color it red. Slide the red image slightly to the left of the blue image. Print it on white paper. Using the red/blue glasses, view it.

Coordinate with the art teacher to create 3-D red/blue drawings using similar techniques. These techniques are also described in the book *Creating 3-D Art*, available from Reel 3-D Enterprises (see Resources).

Using a program like 3-D Maker you can turn your own stereo pair images into anaglyphs in a very short time. You will need a scanner. You can also use Adobe Photoshop to make anaglyphs using subtractive filtration. Instructions for how to do it can be located on the Internet (see Resources).

Show a 3-D anaglyphic movie from the 1950s for fun. Sci-fi, horror, and comedy films were usually made using the 3-D polarization process, but many were transformed into anaglyph versions for television. Some are available today from movie distributors. They are not nearly as good as the polarized 3-D movies shown at most theaters (and in IMAX theaters) but can be fun.

## RESOURCES

Red and blue acetate can be purchased at art supply stores for about \$5 per sheet (20" × 36").

The CD-ROM, *3-D Tour of the Solar System*, and the slide set, *The Solar System in 3-D*, are available from the Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058-1113 (<http://cass.jsc.nasa.gov/lpi.html>). Stereo images produced by Paul Schenk, David Gwynn, and James Tutor.

### *Anaglyphs on the Internet*

**Mars Pathfinder Anaglyph Stereo Image Archive**  
<http://mars.jpl.nasa.gov/MPF/parker/highres-anaglyph.html>

**The 3-D Web**  
<http://www.3d-web.com>

**Geodesic and Animated Anaglyphs**  
<http://www.sover.net/~manx/mark3d.html>

**3-D Funsite at The Turing Institute in Scotland**  
<http://www.turing.gla.ac.uk/funsite/anaglyph.htm>

**The California Museum of Photography**  
[http://cmp1.ucr.edu/collections\\_page/page/3D.html](http://cmp1.ucr.edu/collections_page/page/3D.html)

**Dimension 3**  
<http://www.3dcompany.com/contents.html>

**The 3d Zone**  
<http://ray3dzone.com/index.html>

**Reel 3-D Enterprises**  
<http://stereoscopy.com/reel3d/>

### *Instructions for Using Adobe Photoshop to create anaglyphs*

**The Stereo 3-D Page**  
<http://www.sover.net/~manx/3dhowto.html>  
E-mail: Mark Newbold, [manx@sover.net](mailto:manx@sover.net)

**The Imagination Gallery**  
<http://www.sendit.com/mformat/PANA.HTML>  
Phone: 800-333-0549

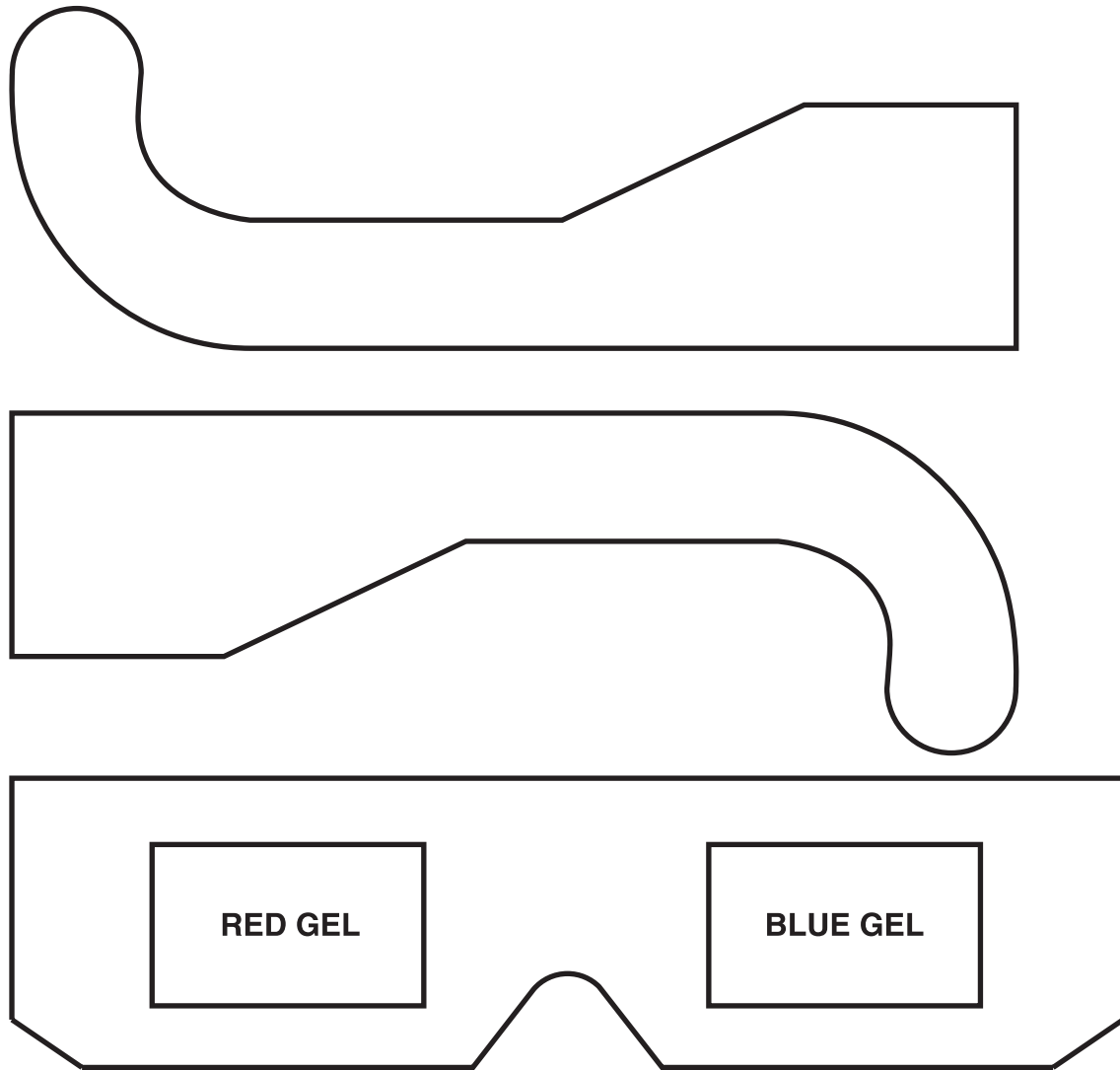
**Synthonic Technologies**  
<http://www.3dtools.com/index.htm>  
Phone: 360-892-1711; e-mail: [3dtools.com](mailto:3dtools.com)  
*A developer of 3D Maker software for creating anaglyphs from stereo pairs.*

*Additional freeware/software that can be used to create 3-D anaglyphs can be downloaded from this site:*

**The Anaglyph Software List**  
<http://freeusers.digibel.be/~guru/3dsoft.html>  
*Available software includes Anaglyph, a Windows program in Japanese and a little English (intuitive); a 30-day trial version of 3D Stereo Image Factory for Windows; and JASC Paintshop Pro.*

## BASIC PATTERN FOR 3-D GLASSES

Cut out this sample pattern and tape the sides to the center section. Use this as the basis for your own design. Be creative! After you are finished designing and cutting out your glasses, carefully tape the red and blue acetate pieces to the eyeholes. Make sure you cut the acetate pieces larger than the opening for your eyes. Try not to get tape on the part of the acetate you are looking through. Be sure to put your name on your glasses.



This side toward face.

In most anaglyphs the red lens is for the left eye,  
but in a very few cases it may be the opposite.