

OVERVIEW

For years, scientists have been using digital satellite images to study objects from space. More recently, digital photography has evolved so that most people carry sophisticated digital cameras in their pockets via mobile phones. How are these images made?

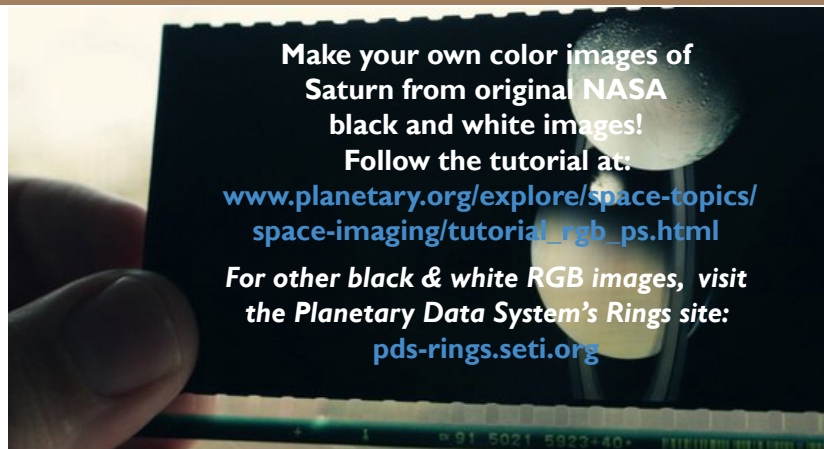
Using simple numeric processing, this activity gives you a basic understanding of how a digital camera works and how the images from *IN SATURN'S RINGS* come to life.

A digital camera uses a lens to project an image onto a light-sensitive surface in a dark chamber. Its electronic sensor then records the image. The sensor is like many tiny solar cells that convert light into electrical energy. The camera's built-in computer logs how much light hits each cell, or "pixel," by recording the electrical charge produced by the cell. If a pixel receives more light, the computer will record a higher number; if it receives less light, it will record a lower number. The digital record looks something like Figure 1 (p. 9).

Once the digital data is recorded, a computer can translate the number from each pixel into a color value, a lot like painting by numbers. For example, a zero may be assigned black, and a nine may be assigned white. In this way, the numeric array in Figure 1 (p. 9) can become an image of Saturn, as we see in Figure 2 (p. 9). The same technique was used by NASA scientists when receiving the first data from the Mariner mission to Mars: solarsystem.nasa.gov/multimedia/display.cfm?Category=History&IM_ID=13006

As you can see, this image of Saturn is not as amazing as those seen in *IN SATURN'S RINGS*. The difference between this image and those in the film is resolution. This image has a small amount of data, or low resolution. It is composed of 36 columns and 28 rows (36 X 28) or 1008 pixels. Many of the images from *IN SATURN'S RINGS* have more than 9 billion pixels! This higher resolution makes the images more than 20,000 times more detailed than Figure 2.

If images from space exploration missions are taken with black and white digital cameras, then how do we get color images from them? To make a color image, pictures are taken through red, green and blue filters. The three separate images are colored, then digitally combined to produce a spectacular full-color image that we may all enjoy.



MATERIALS

- Data Sheet provided on p. 9.
- Downloadable Data Sheet at www.insaturnsrings.com/learn/downloadable-activity-pages

PROCEDURE

1. Reveal the image of Saturn in the Data Sheet on p. 9. This is like "painting by numbers." Print the data sheet and shade in all the squares accordingly:
 - 0 = Black
 - 1 = Dark Grey
 - 2 = Light Grey
 - 3 = White
2. After completing the Data Sheet from p. 9 by hand, if you have Microsoft Excel you can use it on your computer to color the image really fast:
 - a. Open the downloaded Data Sheet on your computer.
 - b. Select all of the numbers in the worksheet.
 - c. Using the Conditional Formatting command (on the Home ribbon), select Color Scales. This option will let you automatically color each numbered cell with the color you've assigned the number.
 - d. To choose the colors for the minimum and maximum values, select More Rules from the Color Scales screen.
 - e. Leaving the Style as 2-Color Scale, try black for the Minimum value and light yellow for Maximum value.
 - f. Press OK to see what happens! Zoom out to sharpen the resulting image.

