LESSON 4: PIXEL PERFECT

OBJECTIVE

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 2 (p. 8).

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 2 (p. 8) can become an image of Saturn, as we see in Figure 1 below. The same technique was used by NASA scientists when receiving the first data from the Mariner mission to Mars: https://www.nasa.gov/topics/history/features/mariner-4image.html

LESSON LENGTH

30 minutes

MATERIALS

- ☐ Data Sheet (Fig. 2) provided on p. 8.
- ☐ Colored pencils or markers (black, dark grey or orange, light grey, yellow). You can also experiment with different colors.

START

Reveal the image of Saturn in the Data Sheet on p. 8. This is like "painting by numbers." Print the data sheet and shade in all the squares accordingly:

0 = Black
1 = Dark Grey or Orange
2 = Light Grey
3 = Yellow

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 1 below.

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.

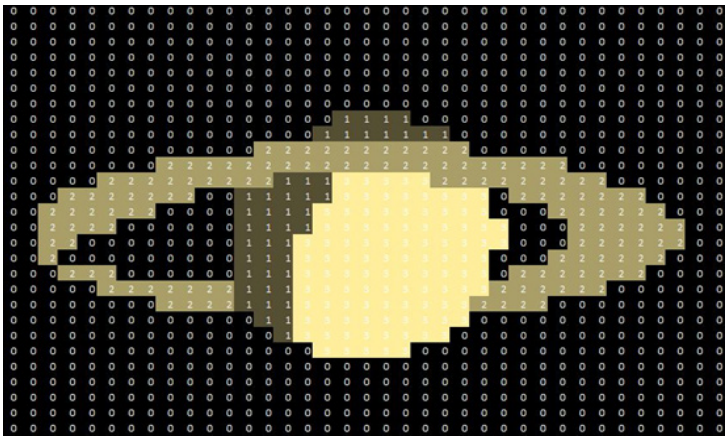

Fig. 1

Make your own color images of Saturn from original NASA black and white images!

Follow the tutorial at:
www.planetary.org/explore/space-topics/space-imaging/tutorial_rgb_ps.html

For other black & white RGB images, visit the Planetary Data System's Rings site:
pds-rings.seti.org

LESSON 4: PIXEL PERFECT (DATA SHEET)

NAME: ____

Reveal the image of Saturn in this Data Sheet like "painting by numbers." Print the data sheet and shade in all the squares accordingly (you may choose other colors, just for fun!):

0 = Black
1 = Dark Grey or Orange
2 = Light Grey
3 = Yellow

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fig. 2