Name:

Cosmic Photoshoot **to ImPress**

During this activity, you will use some of the same tools used by professional astronomers. This will be a challenging activity, but you will find numerous hints embedded to help you complete your project. Raise your hand whenever you need help or have a question - we are here to help!

Create your own "Cosmic Photo"

> *Stars are born in thick clouds of gas and dust. In this activity, you will use images from the Hubble Space Telescope. The example shown here is of the Eagle Nebula, also known as the Pillars of Creation, one such active stellar nursery. Using archival data, you will make your own color images using the same software as professional astronomers.*

STEP 1: Pick your Object. Check out the astronomical objects on the next page and identify which object you would like to make your own cosmic photo version.

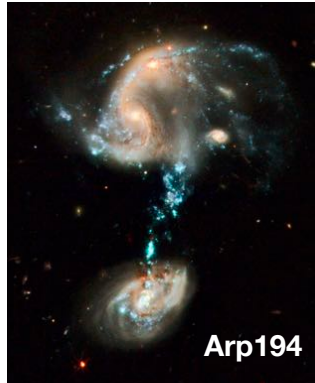**[1] Question:** What object did you pick?

STEP 2: Fun Fact Search. Open a google search and find (at least) 1 fun fact about your astronomical object. `https://www.google.com/`

[2] Question: What is your astronomical object? Write at least 1 fun fact about your astronomical object in the box below.
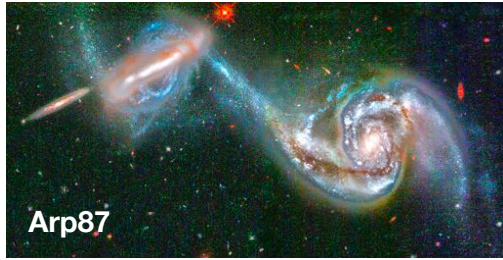
Arp87

Arp194

Arp147

Bubble Nebula

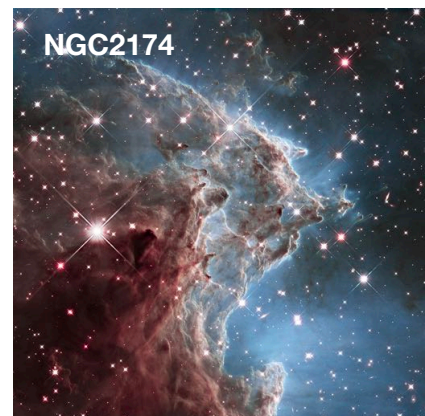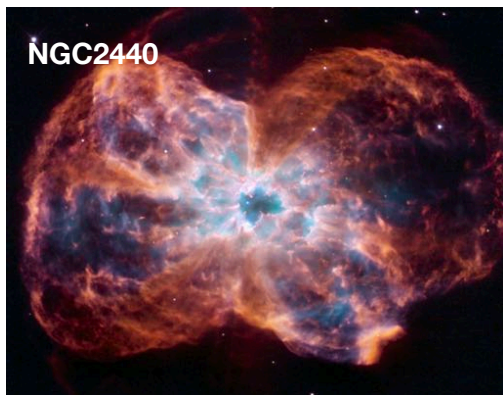Horsehead Nebula

Carina Nebula

Jupiter

NGC6050

NGC2174

NGC2440

Whirlpool Galaxy

M82

Veil Nebula

Pick your object!

STEP 3: Access the Data. Click on the **Eureka/** folder on your desktop and next on the **0-EXAMPLE/** folder. Images from the *Hubble Space Telescope* archive[1].

For our example, you will find two folders (**Optical** and **Infrared**): the Optical folder contains **F505N**, **F657N**, and **F674N**, and the Infrared folder contains **F110W** and **F160W** filters. These images were taken with the Wide Field Camera 3 instrument, currently installed and operational on *Hubble* since the 2009 servicing mission. You can also locate the folder containing the images for your chosen object. Most only have an Optical folder available.

The files are in "FITS" format, where FITS stands for "Flexible Images Transport System". **The numbers at the end of the filename is the wavelength of light that the filter allows through.** The narrow-band filters (appended with "N") allow 502nm, 657nm, and 673nm light through to the detector, and the wide-band filters (appended with "W") allow a wider range of light through centered at 1100 and 1600 nm, respectively (see Figure 1).
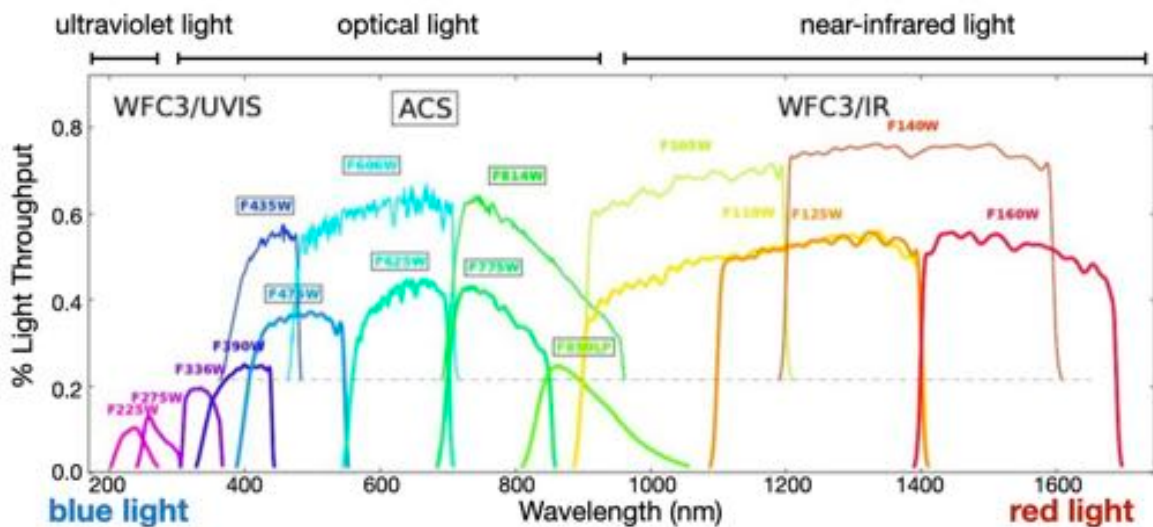

Figure 1 – *Filter transmission curves for different Hubble Space Telescope broadband filters.*

[3] Question: Of the filters available for your object, which filter corresponds to the red image? What about the green and blue images? *(Hint: Use the filters in the filename as a clue — see Figure 1. Remember that longer wavelength = redder filter, but not always a higher number)*

Red Image =

Green Image =

Blue Image =

Name:

STEP 4: Open SAOImageDS9. Now launch SAOImageDS9, a program astronomers use to process astronomical data images. Click on the spotlight search menu in the top right corner and **type "SAOImageDs9" into the search bar**.

STEP 5: Make your own GREYSCALE image. Select file→open within SAOImageDs9. Go to ~/**Desktop/Eureka** folder and find your object's folder and **select one of the images and click open**.

But wait, what is wrong? **Why does the file look BLANK?** Don't worry, it just means the default scaling for the pixel values is bad. Choose a better range with **scale→zscale** to start. You may also need to zoom out, **zoom→zoom out**, until the entire image fits in the frame.

RESCALE: Figure 2 shows image scalings that are "**linear**" (left, the default value) versus "**log**" (right). A logarithmic, or log, representation of the pixel values suppresses the bright parts of the image, like the stars, and enhances the fainter parts, like nebulosity. This can be desirable if the 'faint stuff' needs 'a boost', but a logarithmic stretch function also reduces the contrast in an image. Play around with the scale features for yourself.
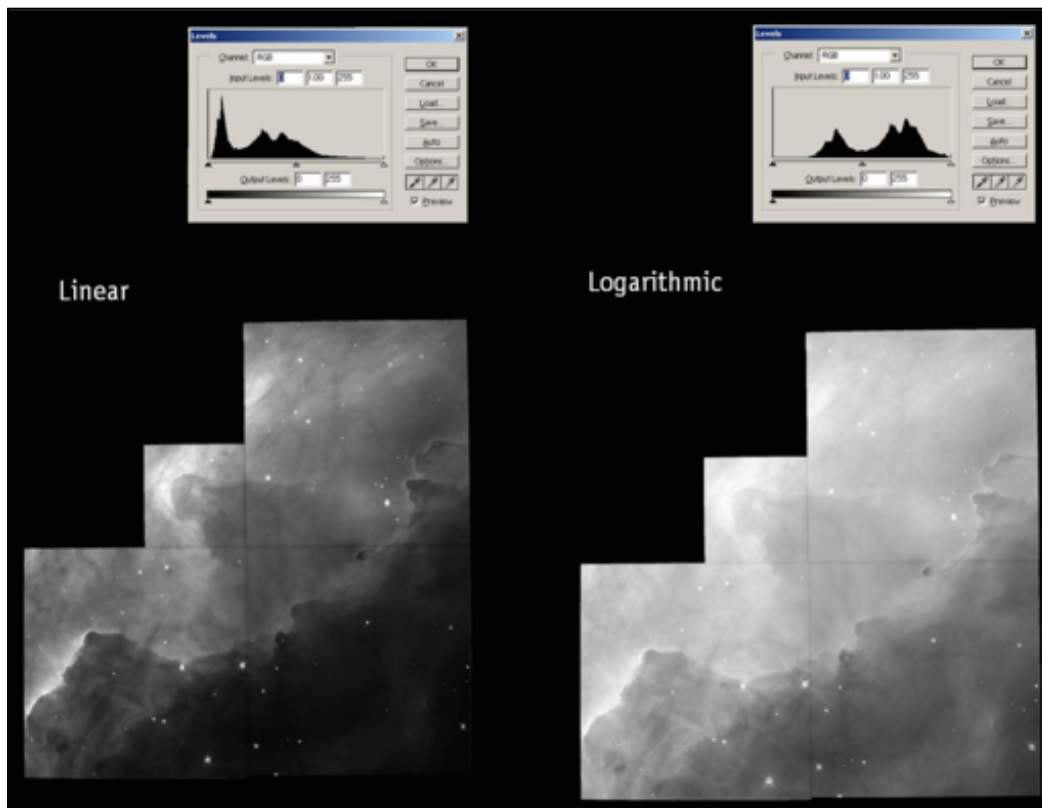

**Figure 2 –** *Linear (left) and logarithmic (right) pixel scaling values in the Eagle Nebula image.*

LOAD MORE FILTERS. Go to **frame→new**, then **file→open** to open the next image file. You might have to redo the scaling and zoom again.

> **PRO TIP:** *Use the Tab key to switch between frames efficiently. Hold down the tab key to cycle through them rapidly. Do the stars and objects in the images look like they are all in alignment? They should be, so if not select **Frame→Match→Frame→WCS**.*

STEP 6: Everything is better in COLOR.

Combine individual images to make a color image with "RGB" (Red Green Blue) frame. Go to **frame→rgb**. The little window (pictured on right) will pop up. **DO NOT CLOSE IT**! **You will have to start over if you do close it.**
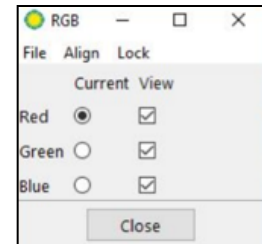
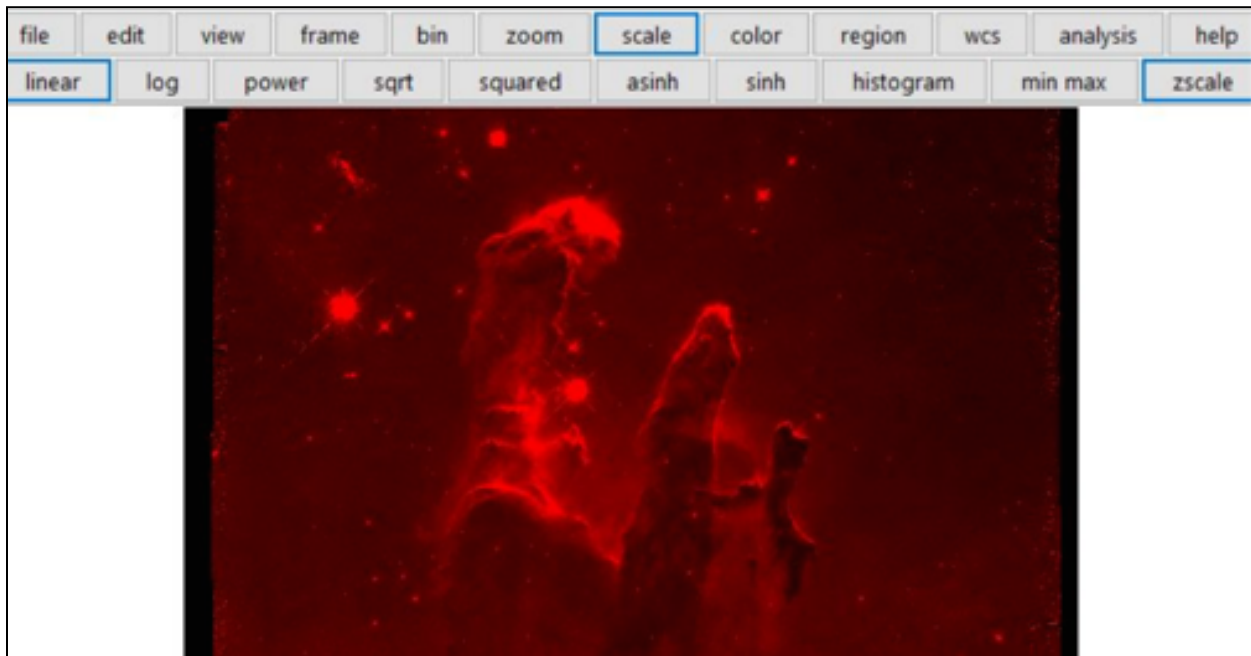Select file that corresponds to the reddest filter (see your answer to Q3). Go to **file→open** and select red image.

Figure 3 – *Example of what you see when loading only the red filter image of the Eagle Nebula.*

Next in little pop-up window, select the green toggle button instead of red. Repeat the **file→open** process to select green image file. The resulting green and red image might look a little weird, but that is okay. Finally select blue in the little box, and repeat the process with the last file.
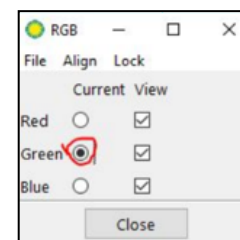
> *This is how astronomers make the space images you might see in books or on the internet. This was a pretty simple process, but a lot more work can go into refining the image, much like the photo editing performed by professional photographers. Time permitting, we will do some of that here.*

STEP 7: Refining your own image. Two other functions we can use are the **scale parameters** and **colormap parameters**.

Go to **scale→scale parameters**. This will open a new window. Generally, the lower limit is best if you leave it at zero, but test this out for yourself. You can also change the upper limit (red circle below), but be sure to note the original number so you can fix it if your changes do something strange.
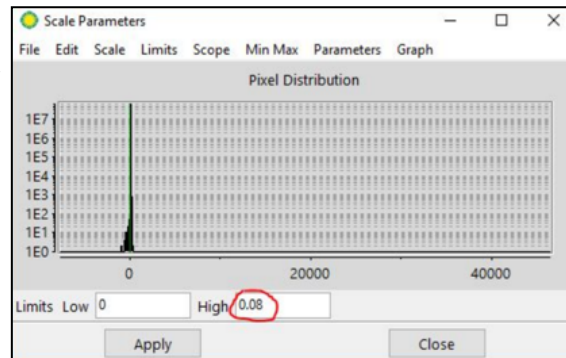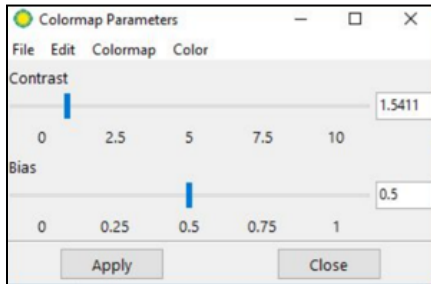
Fine-tune the colors of your image. Go to **colors→colormap parameters**. The window shown at the right here, with sliding bars, opens. Again, remember to make note of the original parameters in case you need to reset.

Switch between the three color layers using the little RGB window. Each layer has its own settings for **scale** and **colormap**. Manipulate each color layer independently to achieve the best looking image by first finding the little window and selecting the layer you want to change, and next fine-tuning the parameters as demonstrated above.

STEP 8: Saving your image. When done, take a **screenshot** and save your picture to print to a tote bag. To do this hold down **command-shift-4**, which will bring up an target pointer and you can drag from the top left to the bottom right before letting go of the buttons. **Rename the desktop file with your name.** Figure 4 shows the example of the Eagle Nebula; even if you picked the same object, yours can look different from this one, or from your friends' pictures. It is your aesthetic decision, after all.

Figure 4 – *Example RGB image of the Eagle Nebula, also known as the Pillars of Creation, created by A. Gibson using SAOImageDS9.*