EDUCATOR'S GUIDE

How Hubble Works

Preparation

Standards

5-ESS1-1

MS-ESS1-2

HS-ESS1-3

Overview and Objectives
This lesson is geared toward students in grades 3–8.

When the Hubble Space Telescope was brought into space in 1990, people on Earth were able to see images they have never seen before due to the telescope's ability to interpret light in a way that humans cannot do on their own. This program discusses how the images we see of space objects are created by the data from Hubble.

This lesson includes a slideshow in which an instructor can lead participants through an exploration of Hubble images. The lesson culminates with participants coloring their own planetary nebula based on Hubble data.

Instructional Modalities

This activity was designed for both synchronous or asynchronous instruction.

For **synchronous instruction**, we recommend a platform that allows both for whole class discussion and for students to interact in small groups.

For **asynchronous adaptations**, we provide suggestions for teachers to provide additional support for the activities and for students to share their work with each other.

Materials

- **How Hubble Works Slideshow**
- **Coloring Pencils**
- **Video Reflection Activity Sheet** (p. 5)
- **Printed Nebula Shapes** (p. 6 - 8)

Lesson

1. **Introductory Activity**
   - Ask Participants::
     - **What are some objects that we can find in space?**
     - **Are those objects close to Earth or far away?**
     - **How can we get information about those objects?**
   - Discuss the responses with the group.

2. **Core Activity**
   - Share image of Hubble Space Telescope and the types of images the telescope has taken
     - **Why was it important to put a telescope in space if we have great and powerful telescopes here on Earth?**
   - Placing a telescope above our atmosphere allows it to take clear images that are not distorted by our atmosphere. if you put your head under water and look up does the sky and clouds look the same? No, the water distorts what you're seeing because light reflects differently through the water. The same happens with our atmosphere.
   - Share video (0:37 - 2:25)of how the images produced by the Hubble Space Telescope are created.
     - **What colors does the Hubble Space Telescope attribute to regions that emit large amounts of infrared radiation?**
     - **What colors does the Hubble Space Telescope attribute to regions that emit visible light?**
     - **What colors does the Hubble Space Telescope attribute to regions that emit large amounts of ultraviolet radiation?**
     - **What happens when Hubble combines these images of the different regions of a space object?**
   - Share slides 9 through 14 to show how different Hubble images are created.
     - **What do you notice about these images?**

- Share blank planetary nebula coloring sheets with students. Have participants decide which color they want to associate with each number and color in their nebula.
- Let participants know that the colors can mix together! The gasses that make up nebulae will often mix, creating different colors for Hubble to see.
- Have participants share their work with a friend
    - **What might a scientist working on an image from the Hubble Space Telescope have to do differently if they wanted to add color to this image?**

Asynchronous Adaptation

Have participants go through the slideshow on their own. Using their worksheet, participants can respond to questions about the video and color their own planetary nebula. Have participants take a photo of their art pieces and share it using Padlet or Google Doc.

Extension Activities

To deepen student engagement with this content, you may choose to add the following activities :

Paint a Planetary Nebula

Print the Planetary Nebula Coloring Sheets on watercolor paper and use watercolor paint to fill in your nebulae! The painted nebulae may take some time to dry.

Help Scientists Identify Galaxies

Have participants visit Galaxy Zoo and help scientists classify galaxies according to their shape.

Additional Resources/ References

The Meaning of Color in Hubble Images:
http://hubblesite.org/gallery/behind_the_pictures/meaning_of_color/

Planetary Nebula K 4-55:
https://hubblesite.org/contents/media/images/2009/21/2562-Image.html?news=true

Southern RIng Nebula:
https://hubblesite.org/contents/media/images/1998/39/729-Image.html

Spirograph Nebula (IC 418):
https://hubblesite.org/contents/media/images/2000/28/990-Image.html?news=true

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ACTIVITY 1: VIDEO REFLECTION

Directions:
Watch the video on how Hubble works and answer the questions below.

1. What colors does the Hubble Space Telescope attribute to regions that emit large amounts of infrared radiation?

2. What colors does the Hubble Space Telescope attribute to regions that emit visible light?

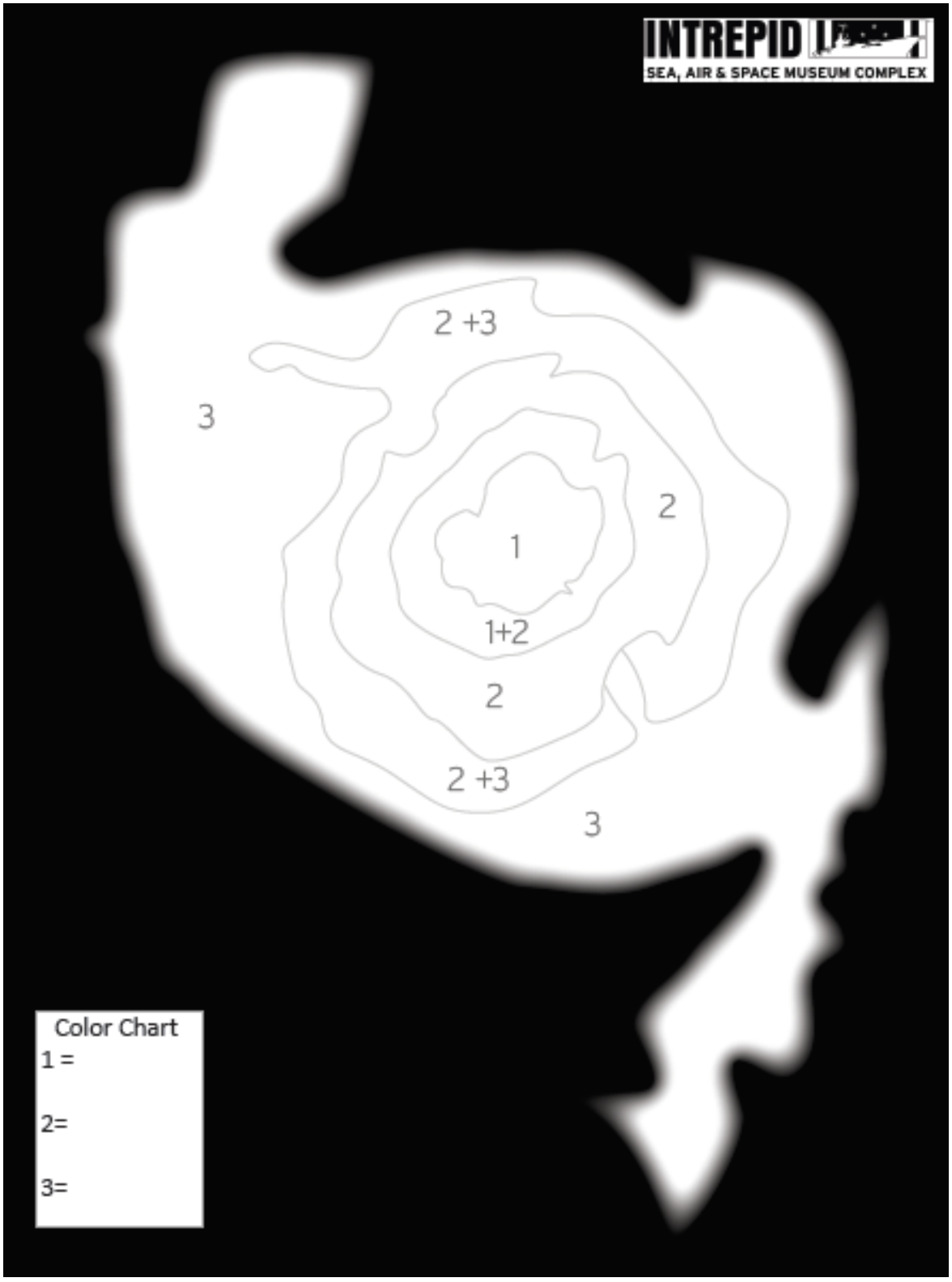
3. What colors does the Hubble Space Telescope attribute to regions that emit large amounts of ultraviolet radiation?

4. What happens when Hubble combines these images of the different regions of a space object?

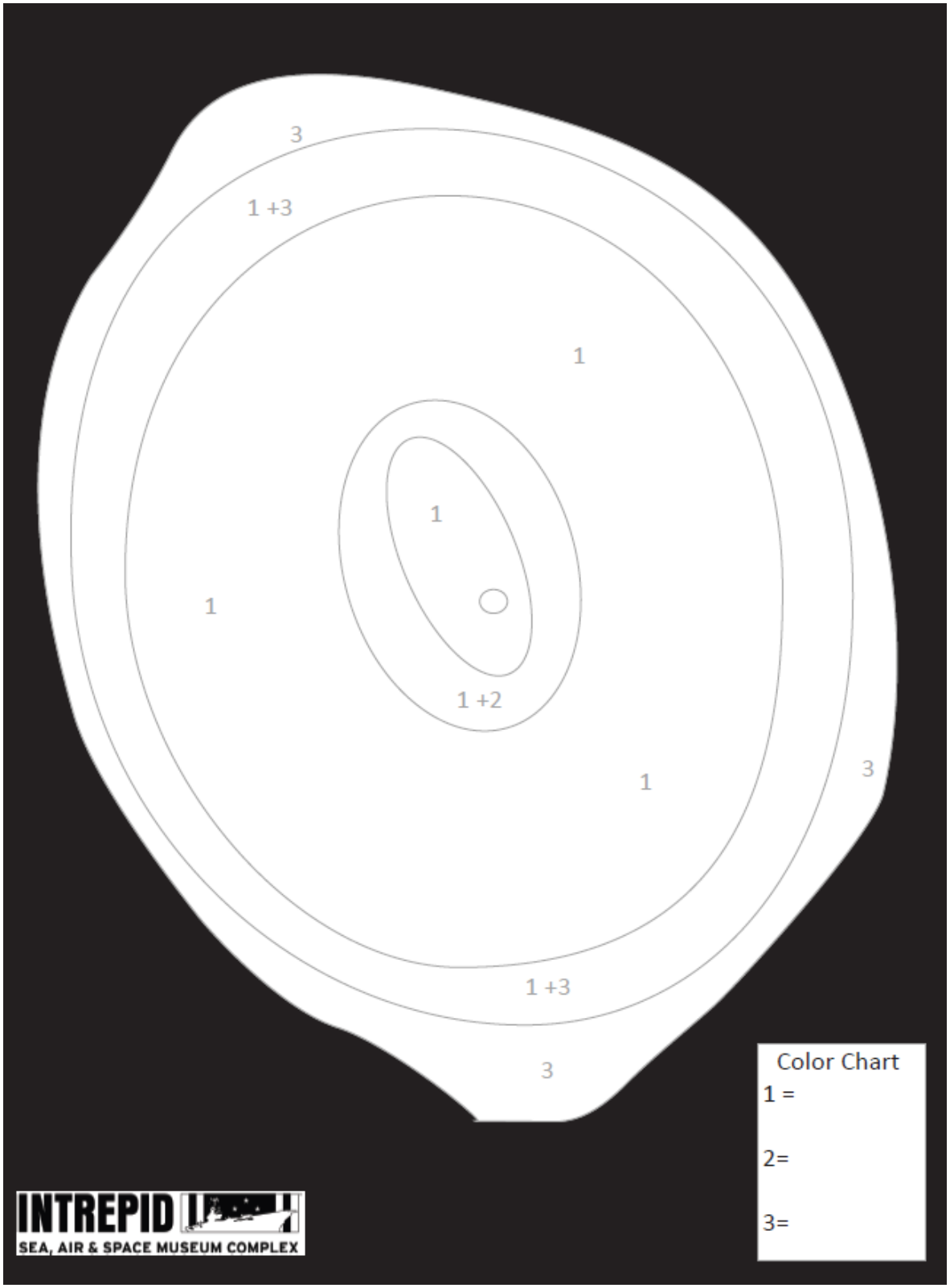
ACTIVITY 2: PLANETARY NEBULA COLORING SHEETS

Directions:
Use coloring pencils to color in the planetary nebulae below or print these sheets on watercolor paper and use watercolor paints to color them in. Decide which color you want to associate with each number and color in the space according to each number.

Southern Ring Nebula



Planetary Nebula K 4-55



Spirograph Nebula (IC 418)