

## Vesta Mosaic: Art Informing Science

### LEADER GUIDE

#### Learning to Look. Looking to Learn!

Albedo is a measurement of the reflectance of a planetary surface. Generally, it is a concept challenging for middle grade students to grasp, and the unusual word becomes one more bit of too-complicated science vocabulary.

Vesta Mosaic helps students learn to look—and look to learn. Using the element of art, value—the relative darkness and brightness of an object or surface—students find a path to understanding the science behind this key concept part of the scientists' paint box.

The premise is straight-forward. A high resolution image from asteroid Vesta is blown up to about 16 x 16 cm, and cut into 16 squares. Each student is given one of the squares to render in hard pastel—in white to gray to black shades—on to a 8 cm x 8 cm piece of pastel paper. Without the larger context of the image, learners have to focus carefully upon their respective portion of it, noticing the finer details—craters and lines, bright and dark areas. Then the drawings are put together to form a composite of the original image.

#### NATIONAL EDUCATION STANDARDS Science

##### Earth and Space Science

- Earth and the Solar System

##### History and Nature of Science

- Science as a Human Endeavor
- Nature of Science

#### Art

##### Visual Arts (5–8)

- Content Standard #1: Understanding and applying media, techniques, and processes
- Content Standard #6: Making connections between visual arts and other disciplines



Source: The National Committee for Standards in the Arts

<http://artsedge.kennedy-center.org/educators/standards/full-text/5-8-standards.aspx>

## MATERIALS

*Per group of 4 students*

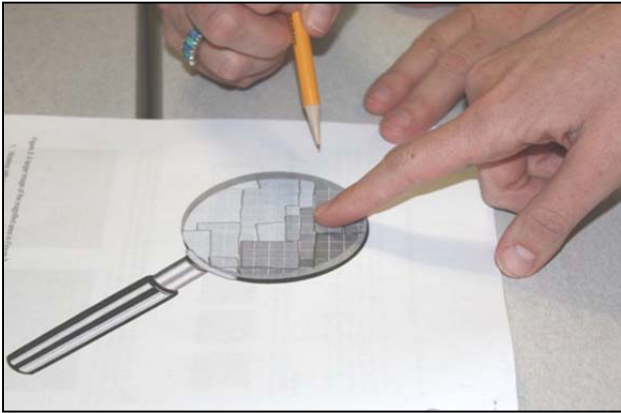
- Gray scale pastels, ideally hard pastels such as NuPastels, or gray scale soft pastels or soft drawing pencils
  - Pastels are readily available in local arts and crafts stores
  - NuPastels are more expensive, but last a long time and are as effective in small pieces
- Q-tips
- Disposable wipes for clean-up (baby wipes are the least expensive)

*Per set of 16 (for smaller groups, kids can render more than one image)*

- Image of Vesta, blown up to at least 8"x8",
  - cut into 16 equal squares (2"x2")
  - Dawn mission website's multimedia section has many images: <http://dawn.jpl.nasa.gov/>
  - You could invite students to choose images that are interesting to them. Those with more extreme light and dark are particularly compelling.
    - Suggested images:  
**Publicia Crater (and friends)**  
<https://dawn.jpl.nasa.gov/multimedia/images/image-detail.html?id=PIA15867>  
**Crater with Unusual Rim**  
<https://dawn.jpl.nasa.gov/multimedia/images/image-detail.html?id=PIA15336>
- Paper
  - cut into larger but proportional sizes, such as 4"x4"
  - white art paper works (copy paper is ok but very smooth, harder to get details), a gray art paper encourages students to examining light and dark the details on their image
- Large piece of paper to mount the individual drawings and reassemble the larger image
  - rubber cement or masking tape

## PROCEDURE

1. Start the discussion by asking students what they know about light.
  - a. Suggested questions:
    - i. What's the difference between light that is reflected and that which is emitted?
    - ii. How does light interact with white objects?
    - iii. Is that different from how light interacts with black objects? Why?
    - iv. How is light related to photography?
2. Ask students read the introduction to the Student Activity entitled "Art Informing Science: Vesta Mosaic." Discuss their thoughts about the introduction. Point out the text box explaining that **albedo** is the amount of whiteness of an object or the amount of light that is reflected from a surface.
  - a. The term is used in astronomy to describe how much light is reflected from planets, moons, or asteroids.
  - b. Albedo is one of the measures that help scientists understand the surface composition of objects in the solar system.
  - c. For a more in-depth experience with albedo, use the activity "Seeing Circles" in the development section of the *History and Discovery of Asteroids* module found on the Dawn website at [http://dawn.jpl.nasa.gov/DawnClassrooms/1\\_hist\\_dawn/](http://dawn.jpl.nasa.gov/DawnClassrooms/1_hist_dawn/).



3. Explain to students that image data from large and small bodies in the solar system taken from spacecraft are originally acquired as a table of numbers, where each number represents the brightness of one pixel (square) in the image. For example, 0 can represent black and 100 can represent white, with each number in between representing a different shade of gray. These numbers can be transmitted back to Earth and converted into digital images. Although digital imaging was first developed and heavily used by the space industry for spacecraft images, it is now common in our lives.

#### Part A

4. Have students practice classifying enlarged pixels using the first set of squares on the next page (see student activity). Suggested answers include  $a = 0$ ,  $b = 20$ ,  $c = 40$ ,  $d = 60$ ,  $e = 80$ ,  $f = 100$ . Have students discuss their decisions with a partner or table group.
5. Point out that the magnified area in *Figure 3* is within the full image of *Figure 2*. Explain that students are now going to put their digital imagery analysis skills to work by analyzing the Hubble image of Vesta, the best image we had of the asteroid until Dawn arrived in July 2011.
  - a. Ask students to estimate the albedo of each area within the large magnifying glass by assigning brightness (or albedo) values to similarly colored gray regions using *Figure 4*.
  - b. Not everyone will interpret the images the same way even though they are looking at the same evidence. That is okay!
    - i. Use the class discussion to highlight the importance of interpretation of evidence to the scientific process.
6. When students have completed the exercise, have them answer the questions that follow *Figure 4* in the student activity.

#### Part B

7. In art, *value* is the measure of light and dark in an image. Value corresponds to the scientific concept of albedo. Through this activity, students will be able appreciate the concept of albedo through carefully examining and rendering the light and dark areas of a small portion of an image.

Now let's have students work with a higher resolution photo of Vesta. Explain that they will collectively recreate a photo from Vesta as if they only had access to only one "pixel" and needed other scientists' data to complete the image. Using pencils or pastels, students will "scale up" a small portion of an image by rendering it onto a larger piece of paper (i.e., they will "scale up" their smaller square).

  - a. Start with a copy of an image that is large enough for students to see some detail. You may choose an image from the Dawn website (<http://dawn.jpl.nasa.gov/multimedia/images>) or any other appropriate image from space.

- b. Depending upon how many students you have, draw a grid onto the back of your chosen image. You may need two or more images to accommodate all of your students, depending upon the size of your class. Number each square and indicate which direction is “up.” If using multiple images, number accordingly (i.e. 1a, 1b, 2a, 2b...).

For example, a 16-square grid might look something like this:

4↑	3↑	2↑	1↑
8↑	7↑	6↑	5↑
12↑	11↑	10↑	9↑
16↑	15↑	14↑	13↑

(back of the image)

- c. Cut out the image squares and set them aside.

**NOTE:** Number the back of your image backwards so you can mount the pieces in the correct order!

- d. Decide how much larger you want the image to become. For example, an 8” by 8” image could be scaled up 2x by making the drawing squares in the grid 4” by 4”. This would result in a drawing that is 16” by 16”.
- e. Measure and cut out the appropriate number of drawing squares.



- f. Draw a corresponding grid onto a larger piece of paper. This grid will guide the composing of the mosaic of student drawings.
- g. Using drawing pencils or pastels have each student render their image square onto their larger, drawing square.
- i. Students may wish to make a grid in pencil on their image to help them place features more accurately, offering a nice mathematics/scale connection

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

- h. As each student completes their image, have them affix it to their associated square on the wall.

**NOTE:** If the originals were numbered correctly, these will mount easily.

8. Questions for discussion and wrap-up

Try *Think, Pair, Share*, each student having a moment to think and jot down ideas, with paired discussion leading to a whole group share out.

- How does our activity shed light (ha!) on the concept of “learning to look, and looking to learn?”
- What might have created the differing features on Vesta?
- We discussed how cameras send data, which assigns a value to an area called a pixel. How did your drawing model that, and how is it not? *Each of our pictures is like a pixel and we were like the camera. However, our eyes and brain picked up a lot of detail from our image; an actual camera would have only one value—shade of gray—averaging out the whole square.*



## EXTENSIONS

- ALL WELCOME to join Dawn’s Citizen Science project, Asteroid Mappers at [http://dawn.jpl.nasa.gov/DawnCommunity/asteroid\\_mappers.asp](http://dawn.jpl.nasa.gov/DawnCommunity/asteroid_mappers.asp). Interpret images for the team!
- For more information on digital imagery and Vesta, invite students to read “The Rest of the Story” in the flashback *More Discoveries...Better Descriptions*, found here [http://dawn.jpl.nasa.gov/DawnCommunity/flashbacks/fb\\_10.pdf](http://dawn.jpl.nasa.gov/DawnCommunity/flashbacks/fb_10.pdf)

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