History and Discovery of Asteroids

Seeing Circles—Studying Albedo

ACTIVITY

Section A

Answer the following questions as you complete this activity.

1. Describe what you know about the way **light** interacts with objects.

The handout, "Ping Pong," contains circles filled with varying shades of black and white. Cut out and arrange the circles in order from darkest to lightest.

2. Describe what you know about how light interacts with black objects.

3. Describe what you know about how light interacts with white objects.

On the back of each circle, write what you think is the percentage of "whiteness" (e.g., the blackest circle would be 0%; the whitest circle would be 100%).

4. Compare your arrangement with someone else. Were there any differences? Why do you think there were differences?

Albedo is the amount of whiteness of an object or the amount of light that is reflected from a surface. The term is used in astronomy to describe how much light is reflected from planets, moons, or asteroids. The following table shows the albedos of some common objects. You will note that albedos are given in decimal fractions rather than in percentages. So, charcoal, with an albedo of 0.04, would have a 4% whiteness.

Substance/Object	Albedo	Substance/Object	Albedo
Charcoal	0.04	Soil	0.05-0.30
Sand	0.20-0.45	Snow	0.6
Granite	0.30-0.35	Moon	0.12
Grass	0.05-0.30	Mars	0.25

Section B

Cut out and arrange the **circles** with variations of each shade. Now, use the same procedure to arrange circles with variations of each shade in order from darkest to lightest. Use the set of circles that you arranged in Part One as your standards. Compare each variegated circle with the solid samples that you classified in Part One. Write what you think the percentage of "whiteness" is on the back of each circle.

Answer the following questions.

1. Was it more or less difficult to arrange these circles than the first set? Explain your answer.

2. As you compare your results with someone else, do you find more or less agreement in arrangements than you did in Part One? Why do think this is so?

Scientists use albedo to help understand the surface features and composition of asteroids. Many factors contribute to an asteroid's brightness, including albedo, diameter, and distance from the Earth. If Ceres and Vesta could be observed from the same distance, Vesta would be brighter. Vesta's albedo is about 0.42 and Ceres' albedo is about 0.11. Using the images of Vesta found at http://neo.jpl.nasa.gov/images/vesta.jpg, cut out and arrange each image as you did in the exercise above.

Answer the following questions.

3. Why do you think Vesta's albedo varies in these images?

4. Complete the following based on the word "albedo."

Definition (in your own words):

Use the word “albedo” in a sentence:

Draw a picture that reminds you of the definition:

Section C

You have just investigated the albedo of two-dimensional objects. But as we know, asteroids are three dimensional and contain many craters and other surface features. What questions do you have about the albedo of three-dimensional objects like asteroids? Let’s study albedo with a 3-D model, using the following procedure.

1. Obtain the following supplies.
   - Styrofoam balls (different sizes and shapes)
   - Flat gray paint
   - String
   - Lamp with 40-watt bulb
   - Protractor

2. Create asteroid models by painting the Styrofoam balls with the gray paint.

3. Use a pencil or other blunt object to make craters of various sizes in the balls.

4. Attach a string to the ball and suspend it from the ceiling.

5. Darken the room and use a lamp with a 40-watt light bulb to shine on the asteroid model from a 90-degree angle.

6. In the space below, draw a picture and describe the shades of light and dark of the model.

Angle of Light	Drawing	Description
Asteroid model is 90 degrees from the light source (straight on).		

7. Attach a string from the lamp (shade or base) to the asteroid model. Using the protractor, change the angle of the lamp to the asteroid model.

8. In the chart below, describe the angle of light, make a drawing, and write a description of the asteroid model.

Angle of Light	Drawing	Description

9. Did the asteroid move or rotate as it was suspended from the ceiling? If not, repeat this process. This time, cause the asteroid to rotate.

Angle of Light	Drawing	Description