



Where Are You?

Teacher Guide

MATERIALS

For each team of four

- o Activity, "[Where Are You?](#)" (for each student)
- o Assortment of food items, particularly fruits and vegetables, from which students can select four food items to represent the following solar system bodies:
 - o Earth: melon (roughly 25.5 centimeters in diameter)
 - o Mars: grapefruit (approximately 13.6 centimeters diameter)
 - o Vesta: raisin (1 centimeter)
 - o Ceres: grape (approximately 2 centimeters)
- Note:** The raisin and grape provide another interesting parallel to Vesta and Ceres in that Vesta is believed to be dry and Ceres has wet conditions.
- o Meter sticks

Setting: To model the distance of planets and asteroids, students will need to work in a large open space such as a football field, gymnasium, cafeteria, or hallway.

PROCEDURE

1. Ask the students who read the flashback "[What CAN You See With a Telescope?](#)": "If a 19th century astronomer observed an asteroid through the most powerful telescope available during that time period, what would this asteroid look like?" Students will recall that asteroids appear as tiny points of light.

Ask the students who read "[I Can See You More Clearly Now](#)" what additional surface features of Vesta the Hubble Telescope revealed to scientists. (exposed mantle, ancient lava flows, impact basins and a flattened side on Vesta.)

Why do they think that Ceres' surface features are not very well-defined in Hubble images? (It was not close enough to Hubble at the time that it was being viewed.)

2. Now show them images of asteroids within star fields available at: http://www.brera.mi.astro.it/sormano/gallery/INDEX.html#Minor_planets (images captured from 1996 to 2003) or <http://neo.jpl.nasa.gov/images/1999an10.html> (taken in 1955). Point out to students that these asteroid images were captured fairly recently using much more sophisticated technology than was available during the 19th century.
3. Mention to students that even two of the largest and brightest asteroids, Vesta and Ceres, only appeared as points of light in the sky when using early Earth-based telescopes. Introduce the activity by explaining that Vesta is actually similar in size to the state of Arizona, while Ceres is comparable to the size of Texas. Explain that the model they will create in class will help them to visualize the size and distance of these two asteroids in relation to Earth.
4. Distribute the activity "[Where Are You?](#)" to each student.
5. Have a variety of food items of different sizes displayed in class. Some should fit the scaled-down diameters (25.5 cm, 13.6 cm, 2 cm, and 1 cm). Be sure to have other sizes as well so that students must do the calculations to select the most appropriate food

model.

6. Explain to students that they will convert the actual diameters of several planets and asteroids to reflect the scale of 1 cm = 500 km. Ask them to show their calculations and refer to the example given for Mercury. It may be necessary to calculate a few more examples with students, before they complete the table in Part 1 themselves.
7. Assemble students into groups of four. As they finish their calculations for Earth, Mars, Vesta, and Ceres, ask them to go to the food display and select the most appropriate representation.
8. Allow time for students to respond to the questions in Part 1. Then have students share their responses to questions 2, 3, and 4 with the class.
9. In Part 2 of this activity, students will create a scale model of the distances of Earth, Mars, Vesta, and Ceres. After students have reviewed the table and answered question number 5, spend some time discussing why it is difficult to create one scale model of the entire Solar System that reflects both size and distance.
10. Before students measure their stride and use it as a unit

discussion by getting students to think about how things become standards in measurements. Some historical examples can be found at:
http://standards.nasa.gov/history_metric.pdf Students

the standard yard as the distance from the tip of his nose to the end of his outstretched thumb. You may also want to ask students who have played in a marching band to share their experiences with standardizing steps.
11. To initiate a post-activity class discussion, use a format similar to a K-W-L Chart (Ogle, 1986). On a board, draw three columns and label with the following questions: *What do I know? What do I want to find out? How could scientists find out?* In the first column, ask students to list what they know about Vesta and Ceres from their modeling experiences. Then, get students to think about what questions they may still have about these two asteroids. List their unanswered questions in column two.
12. Finally, in the last column, students could share some possible technologies that might help astronomers seek answers. If students include the Dawn mission, ask them which of their unanswered questions in column two the instruments on the Dawn spacecraft might answer. If they haven't mentioned the Dawn mission, ask them what kind of instrumentation a spacecraft might carry that could answer some of their questions. Then compare their suggestions with the actual goals of the mission.

Alternative Strategy

Instead of students using their own strides to measure distance:

- 1) Designate one student's stride as the standard or
- 2) Have all students measure their individual strides, then use the class average as the standard.