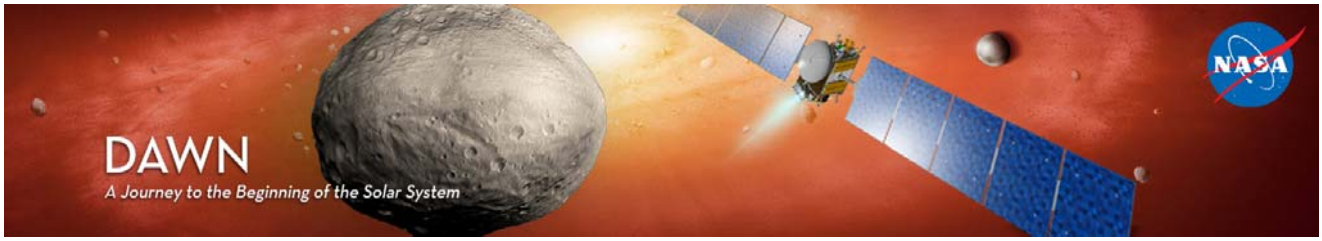

Interaction of Energy and Matter

Mineral Identification

STUDENT ACTIVITY

Words that are bold and italicized can be found in the *Dawn Dictionary* on the Dawn Mission website at http://dawn.jpl.nasa.gov/dictionary/index.asp.

Introduction

In this activity, you will model the process that Dawn scientists will use to identify the surface ***minerals*** of Vesta and Ceres. You will be given:

- a simulated surface of an astronomical body;
- data from each of the instruments that are a part of the Dawn spacecraft payload—Framing Cameras, VIR, and GRaND—that might have been collected by the spacecraft if it had orbited this simulated astronomical body; and
- ***gravity*** measurement information based on changes in ***line-of-sight velocity*** that the spacecraft would have experienced as it orbited the body.

You will be given cards with data about different locations on the simulated surface in much the same format that the Dawn scientists will receive the data from Vesta and Ceres. You will then use this information, as well as that in the *Mineral Standards* data sheets, as a scientist would, to identify an unknown mineral at a specific location.

Procedure

1. Card 1 contains a photograph of a "simulated" surface of a astronomical body that could have been taken by a Framing Camera onboard the Dawn spacecraft. The ***latitude*** and ***longitude*** data for seven different locations are listed in the table.
    a. Locate the site that you have been assigned to determine the type of mineral components at that site in the same way you did in the *Gravity Mapping: Measuring Mass Concentration* activity. You may want to circle that site on the surface photograph.
    b. The table on *Instrument Data,* Card Number 1 also lists some relative ***albedo*** classifications from Framing Camera data for the locations being studied. Remembering that albedo refers to the amount of ***electromagnetic radiation*** reflected from the surface, is there any information in the *Mineral Standards* data sheets that you can use to eliminate any specific minerals as possibilities for your location? Discuss your evidence below.

Place the *Mineral Standards* data sheets for those minerals that you eliminated into a separate stack so that you do not consider them further as possible matches for the mineral found at your assigned location.

2. Card 2 has information regarding changes in line-of-sight velocities, similar to that given in the *Gravity Mapping: Measuring Mass Concentration* activity, related to the specific locations of mineral components. What information in the *Mineral Standards* data sheets relates to changes in the line-of-sight velocities that you can use to eliminate any specific minerals as possibilities for your location? Explain your evidence below.

   Add the *Mineral Standards* data sheets for those minerals that you eliminated to the separate stack so that you do not consider them further as possible matches for the mineral found at your assigned location.

3. "VIR" is the abbreviation for "Visible Infrared Radiation" that will be measured by a ***spectroscope*** onboard the spacecraft. Each location has its own VIR spectrum for the mineral composition at that location, so you will use the unique Card Number 3 for your specific location. Compare your individual spectrum with the standard ***spectra*** as compiled by the *Mineral Standards* data sheets.
   a. Can you eliminate any other minerals on the basis of the VIR spectrum? Explain your evidence below.

      Add the *Mineral Standards* data sheets for those minerals that you eliminated to the separate stack so that you do not consider them further as possible matches for the mineral found at your assigned location.

   b. Can you positively identify the mineral composition at your assigned location on the simulated surface? If so, list it below. If not, explain what other information would be helpful.

4. Let's see if the information on Card Number 4 can help with your decision. It provides specific data that could have been obtained by the GRaND instrument onboard the Dawn spacecraft as it flew over your location. There is also an accompanying table that shows the ***atomic numbers*** for the elements having concentrations greater than a trace in the minerals in all the assigned locations. Use this table and the atomic numbers on the *GRaND Chemical Composition/Concentration Data* card that identifies the specific elements and their percentage composition for your location.

   With this additional information, if you can positively identify the mineral composition at your assigned location on the simulated surface, list it below. If not, what other information would be helpful?

Student Data Sheet

After you have analyzed data from each source (Framing Camera, gravity measurements, visible and infrared (VIR) spectra, and the percent compositions from elements), record the minerals that you think should be eliminated from consideration and your rationale in the chart below.

Data Source	Minerals Eliminated	Rationale	Can You Positively Identify the Mineral? If so, which one?
Framing Camera (albedo, color)			
Gravity (change in line-of-site velocities)			
Visible/Infrared Spectroscopy (spectra)			
Gamma Ray and Neutron Detector (percent composition)			