SPACE ROCKS TELL THEIR SECRETS: SPACE SCIENCE APPLICATIONS OF PHYSICS AND CHEMISTRY FOR HIGH SCHOOL AND COLLEGE CLASSES. M. M. Lindstrom[1], K. W. Tobola[2], K. Stocco[3], M. Henry[4] and J.S. Allen[2] [1]SR/NASA Johnson Space Center, Houston TX 77058, marilyn.m.lindstrom@nasa.gov, [2]Lockheed Martin ESC/JSC, Houston TX, [3]Pasadena ISD, Pasadena TX, [4]San Antonio ISD, San Antonio TX.

Introduction: As the scientific community studies Mars remotely for signs of life and uses Martian meteorites as its only available samples, teachers, students, and the general public continue to ask, "How do we know these meteorites are from Mars?" This question sets the stage for a three-lesson instructional package *Space Rocks Tell Their Secrets*. Expanding on the short answer "It's the chemistry of the rock", students are introduced to the research that reveals the true identities of the rocks.

Since few high school or beginning college students have the opportunity to participate in this level of research, a slide presentation introduces them to the labs, samples, and people involved with the research. As they work through the lessons and interpret real data, students realize that the research is an application of basic science concepts they should know, the electromagnetic spectrum and isotopes. They can understand the results without knowing how to do the research or operate the instruments.

***Space Rock*s Overview:** The instructional package includes the three lessons and an annotated PowerPoint slide show. Besides providing a "tour" of the labs and research, the slide show provides the teacher with background information. Each of the lessons has additional student and teacher background information. The lessons each begin with a hands-on activity that bridges from familiar materials like candy and pennies to research on rocks while introducing a basic science concept. After viewing part of the slide show, a second activity connects the concept to the laboratory work as students use the research data to identify unknowns.

Describing Meteorites: The classification of Antarctic meteorites begins in the meteorite curation laboratory. Here the specimens are examined and described in hand sample, then under a microscope. The classroom activities begin with students observing *Edible Rocks* (candy bars). They write descriptions and make sketches. They learn vocabulary as they compare their work with geologists' descriptions. This prepares them to look at rocks, photos or specimens in the Meteorite Sample Disk. Students learn that careful observation is essential in scientific investigation. They now need mineral compositions to continue the classifications.

Analyzing Minerals: Most techniques for analyzing rocks and minerals use a portion of the electromagnetic spectrum. The instruments in the Electron Microbeam labs use x-ray spectroscopy to determine mineral compositions. The lesson begins with a concept activity related to the electromagnetic spectrum. After the lab "tour" students are given graphs of mineral spectra for known minerals. They become familiar with the data as a set of questions leads them through interpretation, then they identify an unknown mineral. Further discussion reinforces the importance of this data in classifying meteorites. However, they still need isotopic analyses to complete their identifications.

Using Isotopes: Several types of isotopic analyses are important in determining the Martian origin of some meteorites. Radiogenic isotopes yield surprising young ages, noble gases match the Martian atmosphere, and oxygen isotope ratios define a Martian clan. In the classroom, the concept of radioactive decay is introduced in a simple activity with M&M's, while isotope ratios are introduced by weighing *Isotopic Pennies*. After "touring" the Mass Spectrometry Labs where isotopic abundances are determined, students plot and interpret a Rb/Sr isochron and learn about the ages of rocks from various bodies in the solar system. The final activity helps students understand how the fractionation of the stable isotopes of oxygen enables scientists to identify the parent bodies of meteorites. Students then plot oxygen isotopic ratios for known and unknown samples. They are able to interpret their plots and identify Unknown B as a Martian meteorite.

Conclusion: Students have worked through data from three labs that together answer the question, "How do we know these meteorites are from Mars?" The total package demonstrates how scientific investigation builds on previous research and how several lines of investigation work together to support an interpretation.

Space Rocks Tell Theirs Secrets strives to help classroom educators get their students beyond the textbook and closer to the investigation of science. These are not tutorials on using the labs; they are introductions to the research to be used to motivate and build confidence in the emerging science student.

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