

Asteroid Compositions: Colors

Teacher's Notes

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Introduction. Continue your students' involvement with asteroid science! This module extends students' exploration of asteroids into determination of asteroid compositions, probable connections of asteroids with meteorites, and consideration of geologic processes that probably occurred on asteroids. They will see evidence that many of the same processes they are studying on Earth also occurred on the asteroids. Geologic processes are driven by universal physical laws (gravity, friction, fluidity, etc.), the conditions existing in a given environment, and the nature of the materials available. They are not unique to the Earth environment.

This activity, using colors to estimate asteroid compositions, involves making additional observations at the telescope. This activity is designed to take about 3-4 classroom periods, including presentations of, and discussion about, additional concepts, and a few hours in the evening to do the observational activity. As you will see by reading through the directions for doing the color observations, this activity is more complex than "Adopt an Asteroid." In particular, the data reduction requires some mathematics to obtain a useable result. Thus this activity might be more appropriate for Earth Science students in the 8th or 9th grades. On the other hand, it provides a good opportunity for discussing data analysis and uncertainty in measurement and interpretation.

1. Present *The Meteorite Connection*, *Asteroid Colors*, and *Asteroids, Meteorites, and Geologic Processes* that you can download from the NOAO Asteroid web site:

<http://www.noao.edu/education/asteroids/>

Student understanding of different meteorite types is enhanced by letting them see actual samples in addition to the pictures. Collections can often be found at a local museum or planetarium. A representative collection can be borrowed from NASA center education offices. Borrowing these collections requires some training, but the collections come with additional educational materials. Another useful resource is an interactive meteorite identification site at the University of Portland:

<http://meteorites.pdx.edu/ID-intro.htm>

2. Doing the Activity. Provide paper copies of the activity for each student. Make a color copy of the UBV Color Diagram, if possible. It will make reading the graph easier.

3. Connection of Colors to Spectra

Reflectance spectra plus albedos, discussed in the Asteroid Spectra activity, provide complete information about the spectrum of an asteroid between 0.3 and 2.0 microns. Colors, even in the broadband UBVRI, or in the narrow-band 8-color survey, or even in the narrower 20-band surveys, are subsets of the complete spectrum. So why do colors? The colors represent parts of the data – averaged discreet sections of the spectrum – and hence are not as complete as the spectra. However, measuring an asteroid's colors is faster and easier than taking its spectrum, and provides much of the same information. Color data for asteroids are also the byproducts of large existing surveys like the Sloan Digital Sky Survey and the future Large Synoptic Survey

Telescope survey – surveys primarily designed to observe something else. The asteroid colors are essentially “free” data. But to be used, they must be understood, and connected to existing data sets. There are many more color data for asteroids than spectra: half a hundred spectra currently exist, whereas tens of thousands of color measurements exist. So the challenge is to interpret and use the color data to obtain as much information about as many asteroids as possible. Color data are used in statistical scientific analyses. Color data are also often used to identify interesting asteroids that warrant the additional effort of making a spectrum. At present, the taking of asteroid colors and spectra are the two major activities in professional asteroid Astronomy.