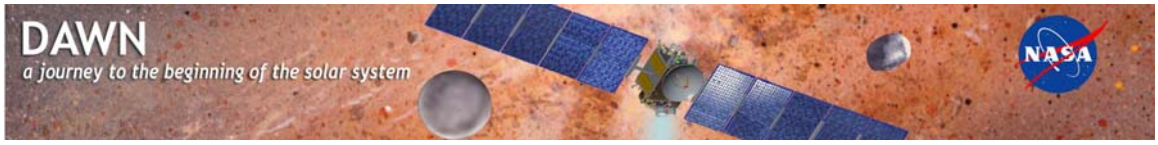
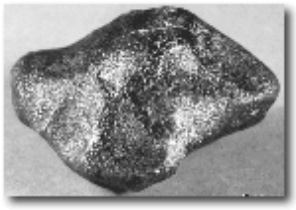


Find a Meteorite

Web Activity

LEADER GUIDE

BACKGROUND



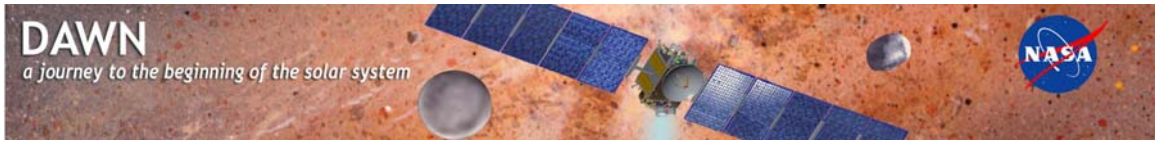
Meteorite from asteroid Vesta

Scientists believe that asteroids contain clues about the conditions and processes acting at the Solar System's earliest epoch. Most meteorites are pieces of asteroids, so when these space rocks fall to Earth, they offer opportunities for scientists to search for clues that help unlock the mysteries of our Solar System's history. By studying meteoritic samples, scientists have some insight into what we may find when NASA's Dawn mission visits asteroids Vesta and Ceres. Comparisons between actual data and the meteorites here on Earth may confirm that we are in possession of very valuable material indeed. The *Find a Meteorite* Web-based activity introduces the importance of meteorites to understanding the Solar System's origins and provides training in identifying characteristics of meteorites. "Finding meteorites is quite difficult because most meteorites look like Earth rocks to the casual or untrained eye. Even to the trained eye, recognizing meteorites can be difficult" (NASA, 1997).

While the *Find a Meteorite* Web activity offers several learning experiences suitable for classroom and informal settings, this leader guide focuses on a two-part activity that can engage learners (ages 10 to 16) in museums, science centers, and other informal learning environments. The "Engage" part, *Meteorite or Asteroid?*, features a slide show that provides learners with a brief introduction to asteroids, meteorites, and the connection between the two. The "Experiment" part, *Meteorite or Meteor-Wrong?,* is a virtual experiment in which learners become familiar with the techniques scientists use in meteorite identification. The optional "Extend" is a hands-on extension that contains its own guide, while the "Explore Asteroids" and "Explore Meteorites" contain additional background information.

The following is a summary of common meteorite characteristics.

- Most meteorites contain at least some **metal,** and those that have a lot of metal tend to be **very dense**.
- If a sample is **magnetic**, it could be a meteorite, but terrestrial rocks can be magnetic.
- Some primitive meteorites have little round pieces of stony material in them called **chondrules**, but some volcanic rocks may have particles that fit this description.
- When a meteorite falls through the atmosphere, it is heated to the point where the outer surface begins to melt. The result is a rock that contains a thin black or brown coating called a **fusion crust**. However, fusion crusts can weather away and therefore may not be present.



- The surface of most meteorite samples have features that look like thumbprints called "**regmaglypts,**" which can vary in size from less than a centimeter up to as much as 10 centimeters.

- Finally, most meteorites will not leave a mark on a "**streak plate**." This will not be possible to test on the Web experiment.

In addition to being familiar with the meteorite characteristics listed above, you as the leader should be familiar with meteors and meteoroids as learners may ask about them: Definitions for each are provided below.

- **Meteoroid** - A piece of rock floating in space. The rock probably came from the asteroid belt between Mars and Jupiter, but some can come from Mars or the moon.
- **Meteor** - "Shooting star." This is what the meteoroid becomes when it starts burning up in our atmosphere. Dust from the tails of comets are also seen as meteors. We also see regular meteor showers like the Leonids (every November) and Perseids (every August) when the Earth travels through dust particles left over from a comet's passage long ago.

Meteorite found in Antarctica
Photo by John Annexstad, NASA JSC

- **Meteorite** – A stony or metallic meteoroid large enough to survive passage through the Earth's atmosphere and reach the ground.

MATERIALS

- Several computers with Internet access (one per learner, pairs or small group) As an alternative for large groups, the leader may have one computer connected to a projector to display the *Find a Meteorite* Web-based activity located at: http://dawn.jpl.nasa.gov/Meteorite/index.asp
- **Optional –** Learner Activity Sheet, "Find a Meteorite Fact Search" (one per learner, pair, or small group)
- **Optional** – Learner Handout, "How Do You Identify a Meteorite?" (one per learner)

Opportunity to Extend Learning

NASA offers an excellent educator guide entitled *Exploring Meteorite Mysteries* that has good background material on meteorites. Available at: http://www-curator.jsc.nasa.gov/outreach/expmetmys/index.cfm

If time permits, prior to the *Find a Meteorite* activity, use lesson three, "Searching for Meteorites" (link to http://www-curator.jsc.nasa.gov/outreach/expmetmys/Lesson3.pdf) from *Exploring Meteorite Mysteries* to help learners model the distribution of materials after meteorites and their recovery on various terrains using geography skills.

PROCEDURE

Part I: Meteorite or Asteroid? – A Brief Introduction

1. Begin the session by engaging learners in a word association. Ask the group what comes to their minds when they hear the word "meteorite."

2. Have volunteers share their responses. There is no need to comment on these responses, but listen carefully to the types of answers that are given. Use this information to guide your instruction for this activity

3. Provide a brief definition of meteorites—space rocks that have fallen on Earth. Then, explain to learners that they will view a brief slide show with some images and information about meteorites, asteroids, and the connection between them. To access the slide show, go to the *Find a Meteorite* Web page: http://dawn.jpl.nasa.gov/Meteorite/index.asp .

4. **Optional** – If you would like to provide more structure for this activity, distribute copies of the Find a Meteorite Fact Search. Learners can preview the questions before the slide show so that they are able to hone in on the important information.

5. If several computers are available, have learners go through the slide show at their own pace individually, in pairs or as small groups sharing a computer. If you are using a computer-projector set up, facilitate learner participation during the slide show by asking learners to predict whether an image shows an asteroid or meteorite and to support their predictions with their rationale.

6. Conclude the slide-show overview by asking learners to think about why astronomers might be interested in meteorites. After learners respond, explain that:

   - Studying meteorites is an easy way to study rocks from other planets or from the asteroid belt.
   - Meteorites can be very old (Ask learners to guess how old). A lot of meteorites formed in the beginning of the Solar System (over 4.5 billion years ago). So meteorites are like having a time machine that can tell us what things used to be like in the beginning of the Solar System.
   - Meteorites can be worth a lot of money. Meteorites that come from Mars can be worth up to $1,000 per gram.
   - Meteorites can cause damage. Some can cause small amounts of damage like holes in roofs, while others can make very large craters. For example, scientists are studying the 65-million-year-old crater in Chicxulub, which has a diameter of about 160km. This particular crater is believed to be the remains of an impact that may have caused the extinction of the dinosaurs.

Opportunity to Extend Learning

For learners who want to study meteorites and asteroids in more depth, encourage them to click on the links to "Explore Asteroids" and "Explore Meteorites" in the navigation bar.

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Part II: Meteorite or Meteor-Wrong? – A Web Experiment

7. Learners may be interested to know about the two boys from Noblesville, Indiana who saw a meteorite falling from the sky and land in one of the boy's lawn. Display an image of the Noblesville meteorite (go to: http://www-

curator.jsc.nasa.gov/outreach/expmetmys/Lesson1.pdf) found on page two of the guide. Ask learners if they came across a rock in their lawn that looked like this, would they suspect it was a precious rock from outer space? Most likely, learners will comment that the meteorite looks like a typical Earth rock. Explain that meteorite identification is a challenge, even for experts, because they may share some characteristics with typical rocks we see in our surroundings.

8. Click on the "*Meteorite or Meteor-Wrong?"* link on the navigation bar. Introduce the activity by telling learners that they will conduct an experiment in which they will get to look at virtual samples of rocks, like those people have sent in for identification, and determine if these samples are meteorites. Based on the three thumbnail images displayed, ask students to predict which are meteorites and which are meteor-wrongs (Earth rocks). You may want to display a tally of meteorite/meteor-wrong predictions for each of the samples.

9. Lead the learners through the series of tests for Sample A. Model the scientific process by asking learners to make predictions, observations, and draw conclusions based on data. Note: With the first few tests, predictions may just be guesses. However, as learners acquire more data, they should be able to make educated guesses prior to conducting the tests, particularly for the magnetic attraction and density tests.

10. If you have several computers available for the activity, allow learners to conduct tests for Samples B and C on their own. If using a single computer-projector set up for the whole group, ask for volunteers to make predictions and actually conduct the virtual tests.

11. After learners have completed the tests for the remaining samples, revisit the group's initial predictions. Facilitate a discussion by asking learners to share any results they found surprising.

12. **Optional**: Distribute the handout, "How Do You Identify a Meteorite?" Explain to learners that the handout summarizes the various characteristics of meteorites and corresponding tests. Encourage learners to conduct tests with actual rocks they find in their own surroundings.

Opportunity to Extend Learning

As a follow-up to this virtual experiment, conduct the series of tests with actual terrestrial rocks with the "Hands-On Extension" available on the *Find a Meteorite* Web site.

Science Standards for Nonformal Education Addressed in the *Find a Meteorite* Web Activity

Scientific Inquiry

Youth will develop the abilities necessary to carry out scientific inquiry and understanding about scientific inquiry

Physical Science

Youth will be able to use and understand properties and changes of properties in matter.

Earth and Space Science

Youth will be able to use and understand earth in the solar system, the study of the region beyond the earth's atmosphere and the origin and evolution of the Earth system.

Science Guidelines for Nonformal Education, developed by Stephan Carlson, Ph.D and Sue Maxa, M.Ed, are available at: http://www.cyfernet.org/science/4h590.html

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