

## Meteors Lesson Plan

**Learning Objectives:** Student will understand the following:

- The difference between meteors and meteorites
- A recovered meteorite is called a fall or find
- Idaho's meteorite history

**Idaho State Standards Met:** K.S.1, 1.S.1, 2.S.1, 3.S.1, 4.S.1, 4.S.4, 5.S.1, 6.S.1, 6.S.4, 7.S.1, 7.S.2, 8-9.PS, 8-9.PS.2, 8-9.ES.4, 9-10.PS.2

**Materials:** A neodymium magnet, a bucket, a plastic bag, and a microscope.

**Background:** A meteor is a flash in the sky or shooting star. A meteorite is a rock from space that hits the earth. Idaho Falls has been hit by a few thousand over time. A study in 2001 estimated that a recoverable meteorite hits the earth at a rate of one per million square kilometers per year. That is an area about four and a half times larger than the state of Idaho. That means that Idaho is likely hit every four and a half years by a meteorite that is recoverable (i.e. big enough to find).

Recovered meteorites are either called falls or finds. A fall is where someone witnesses the event and recovers the meteorite, they are rare. On average, there is one meteor fall per year in North America. A find is when a meteorite is discovered long after it hits the earth with no witnesses. There haven't been any witnessed meteorite falls in Idaho, but there have been five documented meteorite finds in the state from 1895 to 1982.

Idaho's largest meteorite is the 260-pound Oakley iron meteorite on display at the National Museum of Natural History (Smithsonian Institution) in Washington, D.C. It was found in 1926 by two teenage boys who were building a fence and were surprised when their shovels hit a rock that was made of iron. The Oakley specimen is on display because it is one of the finest iron meteorites of its kind. It has a distinctive "bat-wing" shape from its oriented flight through the atmosphere. As it hit the atmosphere at a speed that could have easily been in the tens of thousands of miles per hour, it heated up so much that iron melted and flowed into really cool shapes, cool enough to make it a specimen worthy of display at the Smithsonian.

Even though only a few meteorites have been found in Idaho, the state is hit all the time. It is estimated that 1,000 to 10,000 tons of meteors enter Earth's atmosphere every day. Most of these burn up and never make it to the surface as a recoverable meteorite. But you can actually recover some of this meteorite dust on your own.

**Warm Up:** Ask students the scientific name for a "shooting star." Explain that shooting stars are actually meteors. If the meteor doesn't burn up in the atmosphere and hits the earth, it is called a meteorite.

### **Activity:**

There are a couple ways to recover space dust. One is to use your roof as a meteorite collector. The next time it rains, place a bucket under a drain spout in order to collect a

good quantity of rain water and debris from the roof. Get rid of the leaves and roofing materials and then sift the remains through a bit of old window screen. What you're after is so small that you'll need a very strong magnet (neodymium magnet) to find them. Put the super-strong magnet in a plastic bag to keep it clean. Run the magnet over the sifted debris from the gutter. Chances are the metal particles that collect around the magnet are space dust, also known as micrometeorites.

To make sure, place the collected particles under a microscope - high power will be required to see them clearly. The micrometeorites will show signs of their fiery trip through the atmosphere — they will be rounded and may have small pits on their surfaces, just like the Oakley meteorite.

Another way to find micrometeorites is to collect them in a pan of water. To do so, you will need a fairly large plastic or aluminum container several inches deep, a magnet and a plastic bag. You will want to place the container somewhere high up, as high as possible and in a place where it won't blow over. The reason for height is to avoid as much terrestrial dust (kicked up by cars and other things,) as possible. Also, for obvious reasons, don't put the container under a tree or other obstruction!

Fill the container with several inches of water. You will need to leave the container in place for three or four weeks and you must check it every few days to add water if necessary. In hot weather it is surprising how quickly the water evaporates. To avoid mineral crusts you can even use distilled water. After three or four weeks (the longer the better,) bring your container down and place it on a table. All of the sediment and dust you see in the water is not meteorite dust. To separate meteorite dust from terrestrial sediment use a strong magnet.

Place the magnet in the plastic bag. Slowly move the magnet around the bottom of your collector, making sure to stir up any sediment lying on the bottom. Anything which had been clinging to the magnet through the plastic bag is likely your own personal meteorite collection. You won't likely get more than a few sand grain sized pieces, but what you do get is almost definitely meteorite dust - truly extraterrestrial material.

**Extensions:** Identify the properties of a meteorite in the collected sample. Meteorites are:

- **HEAVY:** Most meteorites contain a significant amount of iron-nickel metal, and are thus heavier (high-density) than rocks typically found at the surface of the Earth. There are exceptions to this rule.
- **MAGNETIC:** Most meteorites contain a significant amount of iron-nickel metal, and are attracted to a magnet. Again, there are a few exceptions of stony meteorites that contain no metal and are not attracted to a magnet.
- **IRREGULAR IN SHAPE:** Most meteorites are irregularly shaped, not round
- **COVERED BY A FUSION COATING:** When a meteorite enters the Earth's atmosphere, friction raises the surface of the meteorite above its melting temperature. As the meteorite descends, it slows down, frictional heating decreases, and the melt quenches to form a fusion coating, a thin layer of dark glass. The fusion coating may be black or brown, dull or shiny on a recently fallen meteorite. After the meteorite has been on the Earth's surface for a while, the fusion coating may rust, giving the outside of the meteorite a reddish-brown coloring, or the fusion coating may erode off partially or completely. Some Earth

rocks can develop a weathering rind (from chemical weathering) on their exteriors that is similar in appearance to a fusion coating. However, there is rarely a sharp boundary between a weathering rind and the interior of the rock. Many meteorites's surfaces develop shallow pits during entry into the Earth's atmosphere. These pits, known as regmaglypts, resemble thumb prints, and are usually better developed on iron meteorites than on stony meteorites.

- **SOLID AND COMPACT:** Most meteorites do not have the bubbly texture (vesicular) that is often found in many volcanic rocks on Earth. There are a few exceptions to this rule.
- **DIFFERENT FROM THE OTHER ROCKS IN THE AREA:** Many meteorites are composed entirely or in large part of metal. These are obviously different from the rocks found on the Earth's surface. The stony meteorites are different in appearance from most types of Earth rocks, but unfortunately are similar in appearance (at least with a fusion crust) to the dark volcanic rocks that are common in Oregon and Washington.