

# METEORITES



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The Anaheim meteorite was found in 1916 about 100 km east of Saskatoon and is believed to have fallen about two years earlier. It is an excellent example of an iron meteorite, irregular in shape, showing very clearly the characteristic deep pitting, dimpling or "thumb printing" of its blackened surface.

## How to identify them

Meteorites are divided into three groups, which vary widely both in appearance and properties. They are: *stones* or *stony meteorites* (known scientifically as *aerolites*), *irons* or *iron meteorites* (*siderites*), and *stony-irons* (*siderolites*).

All usually contain metallic iron compounds and range from mildly to strongly magnetic; the variation in iron content is a major basis for their classification. Meteorites that have lain on or near the Earth's surface for long periods after they fell may be rusted almost beyond recognition.

Despite many resemblances to natural rocks, minerals, slags and metals, meteorites possess a number of distinctive characteristics that aid in their identification. Some may not exhibit these characteristics and may require laboratory tests to confirm their identity.

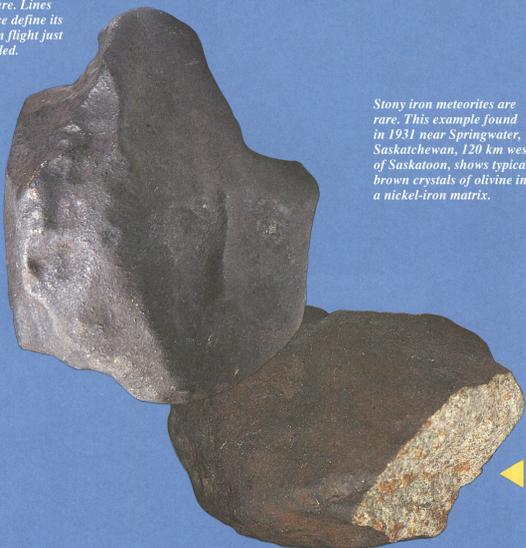
Specimens generally possess a fusion crust, which is dull black to brown in colour, and quite soft. The crust is more prevalent on stones and stony-irons and may have partially flaked off.

Stones are the most abundant and resemble some terrestrial rocks, but are denser. They contain scattered grains of metallic iron; these are visible on broken or polished surfaces, in a silicate matrix. Most (called chondrites) also commonly contain spheres of silicate minerals called chondrules. A photograph of a chondrule is shown above (next to the crater photo); these are generally visible to the naked eye in broken or cut specimens. Theories about their origin vary, but some may date from the very early stages of the formation of the solar system. Rare stony meteorites without chondrules are called achondrites.

Irons and stony-irons are very heavy masses of metal with up to equal amounts of silicate minerals, are strongly magnetic, and are often irregular in shape.

The illustrations on this side of the poster show different kinds of meteorites and contrast them with other objects commonly mistaken for meteorites.

This sample, from the Bruderheim, Alberta, fall of 1960, shows the typical blackened and somewhat shiny surface of a fresh stony meteorite, formed as it was melted by frictional heating in the atmosphere. Lines on the surface define its orientation in flight just before it landed.



Stony iron meteorites are rare. This example found in 1931 near Springwater, Saskatchewan, 120 km west of Saskatoon, shows typical brown crystals of olivine in a nickel-iron matrix.

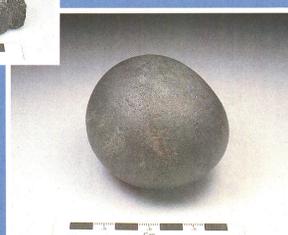


Fresh stony meteorites often have a light coloured interior in contrast to the dark surface.



### These are not meteorites

Materials often mistaken for meteorites include: grinding balls (lower right), which though dense are much smoother than any meteorite; weathered sedimentary rocks (upper left), which are much more pitted and layered than meteorites; and glassy furnace slags (centre), which have a very low density and have been completely molten.



## What are they?

Meteorites are rocks that have fallen to Earth from outer space. Their sizes vary from that of a pinhead to masses weighing several tonnes.

Large ones may impact with sufficient force to produce craters a kilometre or more in diameter, such as the New Quebec Crater situated in the Ungava Peninsula of northern Quebec. It is a classic example of a simple, relatively small meteorite crater. Measuring 3.2 kilometres in diameter with a central lake 252 metres deep, it was formed about a million years ago. We know that even larger meteorites have struck the Earth in the past, because of large craters called *astroblemes* many tens of kilometres across. These meteorites must have been completely vaporized by the force of the impact, and only the scars remain.

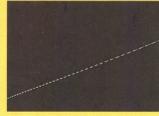


Surface processes on Earth have buried or disguised astroblemes, but such craters are clearly visible on other planetary bodies.

Small meteorites generally land with little effect and are found at shallow depth or loose on the Earth's surface. In rare instances, they have become embedded in buildings or automobiles, but there is only one record of a person being struck. Thousands of meteorites have been found in Antarctica, where they fell on ice and were preserved, transported by ice and exposed thousands of years later. Although meteorites may differ widely in their chemical and physical properties, they all have one important point in common: they are of *extraterrestrial* origin, coming from space beyond the Earth's atmosphere.

Meteorites are related to, but quite distinct from, *meteors*, which are the "shooting stars" that are often seen streaking through the night sky with a brilliant, silvery light. Meteors are actually the incandescent paths that objects produce on their fiery flight through the Earth's atmosphere. The brilliant fragment, its tail, as well as the glowing debris it sheds in flight, produce a luminous *fireball* streak. They may even break apart explosively with the sound of thunder. The fragments and pieces of extraterrestrial objects that reach Earth are what we call meteorites. Of course, objects that are not extraterrestrial, such as satellites, space ships and rocket debris, can also produce fiery paths as they re-enter the atmosphere.

Meteorites probably originate when comets or small planets—called *asteroids*—collide with one another in space. Their orbits may also be changed by gravitational forces, and they become set on collision courses with Earth. Each incoming fragment is set ablaze by the tremendous friction developed as it hurtles through the atmosphere. Most fragments burn up completely, but fortunately some survive. A *meteorite fall* may consist of only one specimen or a *shower* of several hundred. Very few fireballs have been tracked accurately enough to enable their meteorites to be recovered, but such an event occurred near Innisfree, Alberta, in 1977. A special network of cameras recorded the fall with such accuracy that pieces of the meteorite were found quickly, and the pre-collision orbit of the parent body could be calculated. Only two other events have been so well documented.



Meteorites have been put to many uses. A tribe of Alberta Indians used one as a fetish or ceremonial stone. The famous Black Stone, held most sacred throughout the Islamic world, is believed to be a meteorite. In early Asia Minor, iron tools were fashioned from meteorites and, in more recent times, a lump of metal used as a barn doorstop on a farm in western Canada turned out to be a meteorite. Today meteorites are being used to make jewelry.

## Their importance to you

Because meteorites are samples of extraterrestrial material, they are invaluable as a source of information for scientists. Knowing the distribution of asteroids may be important for space exploration. Similarly, knowing the likelihood of major

impacts on Earth is important to life itself; ancient collisions may have caused catastrophic extinctions of many species. All meteorites contain clues about the nature of the solar system, and because most are probably pieces of broken planets, they provide important information about the interior of the Earth. Others show evidence of forming in a vacuum, while some have been subjected to intense heat and pressure. Some are now known to have come from the surface of the Moon, and others perhaps from Mars.

For these and other reasons they are in great demand by the Geological Survey of Canada, and by Canadian universities and museums. A national collection of more than 700 meteorite specimens from more than 400 sites worldwide is maintained by the Geological Survey in Ottawa for research and display. The importance of the National Meteorite Collection is such that the Geological Survey will pay \$500 or more for the first specimen of any Canadian meteorite. Payment has already been made for a number of specimens submitted by amateur collectors.

Should you find a specimen possessing the apparent characteristics of a meteorite, please send it to:

Geological Survey of Canada  
601 Booth Street  
Ottawa, Ontario, K1A 0E8  
Attention: Meteorite Identification

The specimen will be examined and reported on free of charge. Payment will be made after positive identification. If the specimen is too large for mailing, a letter describing its appearance and exact location should be sent.



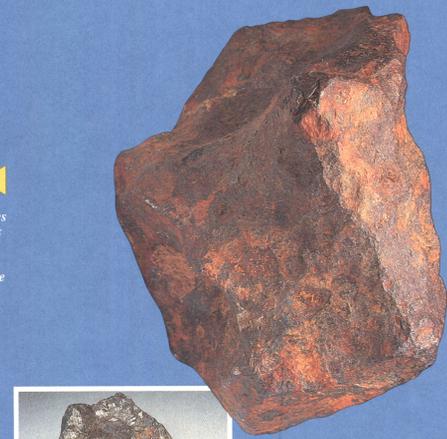
Location map for meteorites found in Canada. Red dots indicate those recovered soon after their fall was observed. Green dots locate specimens discovered by chance many years after they fell.



Both naturally occurring and man-made materials are often mistaken for iron meteorites. The rounded and bulbous sedimentary concretion (lower right), although rusty looking, is non-magnetic and less dense than an iron meteorite. Neither does it have the same kind of surface dimpling as this specimen (centre) from Anaheim, Saskatchewan. The blast-furnace slag (upper left) is also non-magnetic and porous; its surface features indicate that all the material was once molten, while only the surfaces of meteorites have been melted.



Weathered rocks (lower left), containing minerals or grains of contrasting hardness to their matrix, can be mistaken for meteorites. Stony meteorites do not show protuberances, and weathered varieties, like this one from Blithfield, Ontario, (upper right) are rusty even on broken surfaces.



Man-made materials such as the specimen of ferro-manganese alloy (lower left) may resemble iron meteorites, but are non-magnetic and lack the telltale surface features. Weathered or adhered material is not rusty like the Canon Diablo meteorite shown here (upper right).

