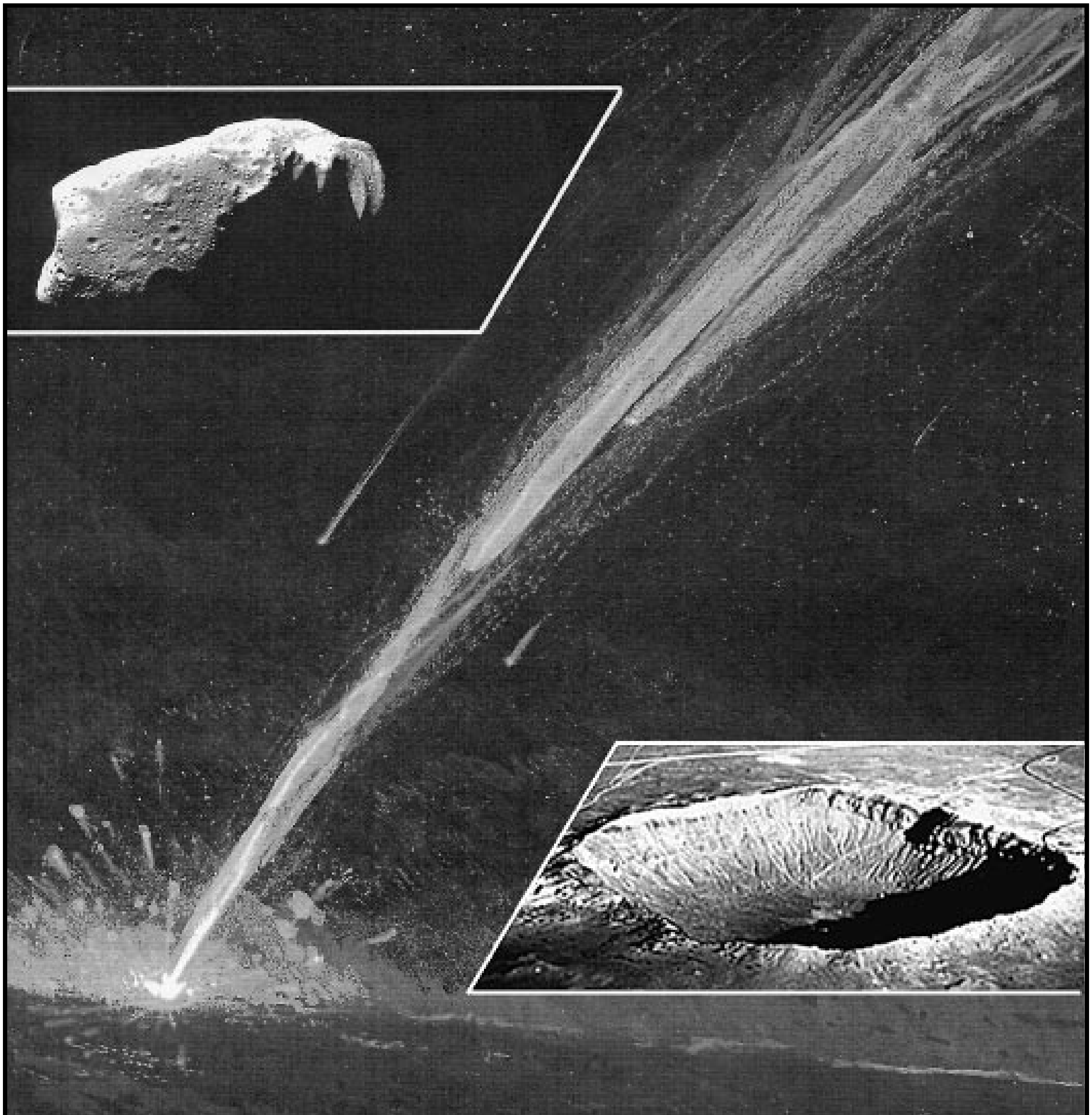
National Aeronautics and
Space Administration

Educational Product	
Teachers	Grades 5-12

Exploring Meteorite Mysteries

Slide Set with Script



ES-1997-08-001-HQ

About this Slide Set

This set of forty-eight 35 mm slides has been prepared to supplement the activities in the *Exploring Meteorite Mysteries* book. The slides and narrative descriptions are divided into four parts. The first 25 slides present a general introduction to meteorites and what they tell us about the history of the solar system. It begins with observations of meteorite falls, depicts meteorites and their formation processes, and concludes with their impact on life and future exploration of the solar system. The remaining three parts are more detailed sections for use with various lessons in the activity guide. These sections reuse some of the slides from the introduction. One section on impact craters illustrates craters on Earth, the Moon and other planets. The next section on classification and formation depicts various meteorite types and the processes of accretion, differentiation, volcanism, and impact. The final section shows collection, curation, and research on Antarctic meteorites.

The slide set is distributed to educators with the Meteorite Sample Disk. Anyone desiring a permanent copy of the slide set may order it at cost from NASA Central Operation of Resources for Educators (CORE). The address for CORE is listed at the bottom of this page.

This slide set was produced by the Planetary Missions and Materials Branch at NASA Johnson Space Center.

About the *Exploring Meteorite Mysteries* Book

The study of meteorites provides a unifying theme that links almost every aspect of Earth and planetary science with mathematics, physics, chemistry, and even biology. The effects of meteorite impacts have serious implications for social science. The activities in *Exploring Meteorite Mysteries* are designed for upper elementary to high school levels. Many of the lessons begin with a simple activity and build to more complex ones. The Curriculum Content Matrix, Lesson Topic Planner and Lesson Sequence Suggestions may assist teachers in integrating the meteorite activities with their existing Earth science curricula and standards requirements.

The Teacher's Guide, *Meteorites, Clues to Solar System History*, gives a broad introduction to many aspects of meteorite science. It tells the story of solar system history from the formation of the planets to catastrophic impacts on Earth. It helps the students learn how scientists use studies of these rocks from space to decipher that history. The Meteorite ABC's and Solar System ABC's Fact Sheets contain important information about meteorites and bodies in the solar system in convenient table format.

To obtain a copy of *Exploring Meteorite Mysteries* (EG-1997-08-104-HQ) contact:

NASA CORE
Lorain County Joint Vocational School
15181 Route 58 South
Oberlin, OH 44074
Phone (440) 774-1051, Ext. 249 or 293
Fax (440) 774-2144
E-mail nasaco@leeca8.1eeca.ohio.gov
Home Page: http://spacelink.nasa.gov/CORE

Exploring Meteorite Mysteries

Part I. Introduction

(may be used with Lesson 1)

Meteorites are rocks that fall to the Earth from space. Meteorites, large and small, have been hitting our planet for billions of years and they still hit today. They are collected and intensely studied by scientists. Meteorites are samples from remote parts of our solar system, with histories that extend back billions of years.

1. Noblesville fall

It was nearly dusk on the evening of August 31, 1991, in the small town of Noblesville, Indiana. Two boys, 13 year old Brodie Spaulding and 9 year old Brian Kinzie, had just finished riding bikes and were standing talking on Brodie's lawn. Suddenly they heard a low-pitched whistling sound and Brian saw an object spinning through the air past Brodie. The object, which looked like a rock, landed with a thud on the ground near them. The boys picked up the rock and found it slightly warm. They looked around, but couldn't find anyone who might have thrown it.

Several days later a scientist from Purdue University confirmed that the rock was really a meteorite. The boys let scientists have a small portion of their meteorite for scientific studies. In 1996, though they have been offered several thousand dollars for it, the boys still owned their rock from outer space. *(Photo by Michael Lipschutz, used with permission)*

2. Noblesville meteorite

This is Brian and Brodie's rock, now known as the Noblesville meteorite. It is a typical stony meteorite, gray inside and covered with a dark crust. About 30,000 small meteorites like Noblesville fall on Earth each year, but only a few are found. In the 200 years since people have understood that meteorites are from space, only about 800 meteorites have been found right after they fell. *(Photo by Cecilia Satterwhite, NASA JSC photo S91-50055)*

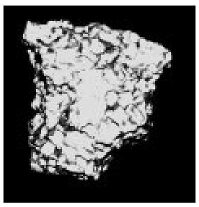
3. Painting of the Sikhote-Alin fireball

Large meteorite falls are rare, about one every ten or twenty years over the whole Earth. One of the most spectacular occurred in 1947, in the Sikhote-Alin mountains of eastern Russia. There were only a few small villages and farms in the dense forests of Sikhote-Alin. Mid-morning on February 12, the calm was shattered by a bright meteor, visible for more than 300 kilometers, that streaked across the sky, shedding sparks and leaving a trail of swirling smoke. An eyewitness painted this impression of the meteor. After it streaked over the horizon, great explosions roared and echoed from the hills, so loud they were heard 100 kilometers away. Some airplane pilots saw the meteor and soon after found where the meteorites fell. *(NASA JSC photo S79-29470)*

4. Sikhote-Alin forest

Clearings in the thick forest were blasted open by the impact. There were 106 craters and holes in the forest where the meteorites had landed. Explorers found many pieces of iron meteorite in the forest, and 150 kg of iron in the largest crater, which was 26 meters across and 6 meters deep. The force of the impact had thrown stones farther than a kilometer. Some of the meteorites were embedded in trees!

Explorers found over 23 tons of iron meteorites from this fall. The Sikhote-Alin meteorite was probably a piece broken off an asteroid. It must have been larger before it hit the Earth, because some of it vaporized in the atmosphere and on impact. *(Photo by Kirov expedition, courtesy of the Smithsonian Institution)*



5. Sikhote-Alin meteorite

This is one fragment of the Sikhote-Alin meteorite. It is about 15 cm across. The photograph shows the original meteorite surface, melted into thumb-print shapes during its flight through our atmosphere. *(Photo by Carl Allen, NASA JSC photo S94-43472)*

6. Meteor Crater, Arizona

Larger meteorites are extremely rare, but make enormous craters when they hit the Earth. Meteor Crater in Arizona is over one kilometer across and 150 meters deep. It was formed about 50,000 years ago when a large iron meteorite hit the Earth. Scientists estimate that the meteorite weighed one million tons. However, the meteorite was shattered and vaporized by the force of its impact and only small pieces survived. *(NASA JSC photo S78-33855)* **Note:** Slide was reversed in production. Flip horizontally for showing.

7. Desert collection

Small meteorites fall to Earth each year, but most aren't seen because they hit in the ocean or in unpopulated areas. Many meteorites have been found in deserts, where the heat and dryness have kept them from rusting away.

When meteorites are discovered, they are called finds. Over 2,000 meteorite finds have been made around the world. Some of these meteorites were on Earth for hundreds of thousands of years before being found. *(Photo by Michael Zolensky, NASA JSC photo S94-44547)*

8. Meteorite in Antarctica

The best collecting place in the world is Antarctica, where meteorites fell on the ice and were preserved in it. Here, scientists traveling on snowmobiles have found a meteorite, and have taken pictures to document their find. Since 1969 scientists have found thousands of meteorites in Antarctica. *(Photo by John Annexstad, NASA JSC photo S80-35602)*

9. Meteorite curation

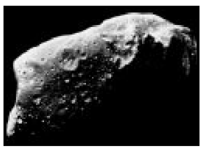
Meteorites collected by U.S. expeditions in Antarctica are sent to this clean lab at NASA's Johnson Space Center in Houston, Texas. There they are described, classified, and distributed to researchers around the world for study. *(NASA JSC photo S96-13391)*

Where do they come from?

Most meteorites come from asteroids, rocky bodies orbiting between Mars and Jupiter. Recently we have learned that a few meteorites have been blasted off the Moon and the planet Mars.

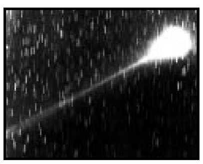
10. The solar system

Although people have seen meteorites fall since the earliest times, it was only about 1800 when scientists finally became convinced that rocks really did fall from the sky. Since then, we've discovered that most meteorites come from the asteroid belt, the area of the solar system between the orbits of Mars and Jupiter where many asteroids orbit the sun. *(Artist's conception, NASA JSC photo S79-29468)*



11. Asteroid Ida

Asteroids are small planets, fragments of rock and iron left over from the formation of the solar system or the breakup of larger fragments. Many asteroids probably look like Ida, the asteroid in this picture taken by the Galileo spacecraft in 1993. Ida is about 30 kilometers long, is made of rock, and has many craters. *(NASA Jet Propulsion Laboratory)*



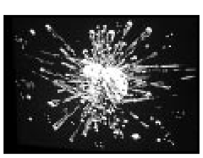
12. Comet Giacobini-Zinner

Comets are small bodies made of rock, dust and ice, formed in the distant reaches of the solar system. Some comet orbits take them near the Sun. Then solar radiation heats the comet's surface, causing part of the ice to boil off into space and carry some of the dust with it. When this happens the comet can develop a "tail" millions of kilometers long, and leave a dust trail behind in solar orbit. *(NASA Jet Propulsion Laboratory)*

When the Earth crosses a comet's trail some of the dust enters our atmosphere and burns, making bright streaks called meteors in the sky. Some of the particles do not burn, but stay in the upper atmosphere, where we can collect them with high-flying aircraft. Scientists call these "interplanetary dust particles," or more simply "cosmic dust."

13. Asteroid in space

Larger meteorites, though, don't come from comets but from asteroids. It's a long way from the asteroid belt to the Earth, and very few asteroid pieces get the chance to travel that far. Most asteroids never do, and spend eternity in space, quietly orbiting the Sun. *(Artist's conception, NASA JSC photo S79-29481)*



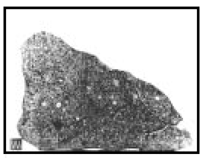
14. An asteroid collision

Every now and again, though, the orbits of asteroids cross and their quiet times end. Then the asteroids collide and shatter, and the pieces fly into different orbits around the sun. Some of these pieces orbit closer and closer to the sun. Eventually some of their orbits cross the Earth's orbit, and the piece of asteroid can hit the Earth. *(Artist's conception, NASA JSC photo S79-29478)*

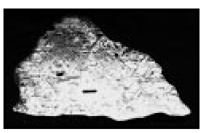
15. Meteor
As the asteroid fragment approaches the Earth, it passes through our atmosphere where friction heats it white hot. We see this moving flame as a meteor crossing the sky. If the asteroid fragment is big enough, fist-sized or so, it won't burn up completely and will fall to the Earth as a meteorite. These small meteorites do not explode or make craters when they hit. They just hit like an extra large hailstone or a rock thrown from across the street. Newly fallen meteorites are usually found sitting on the ground, a rock that wasn't there the day before. *(Artist's conception, NASA JSC photo S79-29471)*

What are they?

The Noblesville and Sikhote-Alin meteorites are examples of the two major types of meteorites. Noblesville is a stony meteorite, the most common type, while Sikhote-Alin is a much rarer iron meteorite.

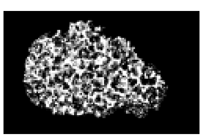


16. Stony meteorite
Stony meteorites are commonly made of familiar minerals like plagioclase, pyroxene, and olivine. Scientists believe that they were formed in the outer parts of asteroids. Stony meteorites look a lot like Earth rocks, and are often not recognized as meteorites. Their outer surfaces are usually melted as they pass through our atmosphere, giving them dark "fusion crusts." That is why the outside of the Noblesville meteorite looked so dark. *(Photo by Cecilia Satterwhite, NASA JSC photo S94-44343)*

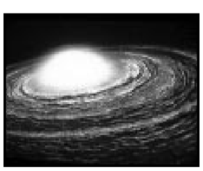


17. Iron meteorite
Iron meteorites are made almost entirely of iron metal with some nickel. As with stony meteorites, iron meteorites also have fusion crusts and show distinct molten metal shapes and flow markings, like those on the fragment of Sikhote-Alin.

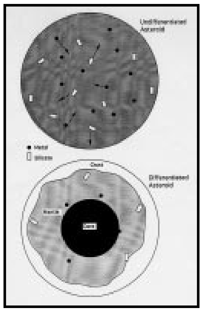
Inside, many iron meteorites are made of criss-crossing intergrown crystals of two different iron-nickel minerals. The sample of the iron meteorite in the Meteorite Sample Disk has an etched surface that shows these patterns. *(Photo by Carl Allen, NASA JSC photo S94-43470)*



18. Stony-iron meteorite
Some meteorites are mixtures of iron and fragments of rock; they are called stony-iron meteorites. This sample, like the one in the Meteorite Sample Disk, formed at the boundary between the metal core and the rocky mantle of an asteroid. *(Photo by James Holder, NASA JSC photo S94-44546)*



19. Solar nebula
The story of meteorites begins 4.6 billion years ago. The solar system began as a spinning cloud of gas and dust, called the solar nebula, which collapsed under its own weight to form a new star, our Sun. As the solar nebula spun and churned, dust grains stuck together to form dustballs, and huge bolts of lightning melted them into small spheres. These solidified into rocky balls called chondrules. *(Painting by Don Dixon, NASA JSC photo S76-25001)*



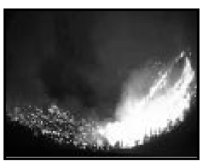
20. Differentiation

Some very primitive meteorites are just masses of chondrules stuck together. In most meteorites, though, the chondrules have been partially or totally destroyed. To destroy chondrules takes a lot of pressure and cooking time, so much that these meteorites could not have formed as small rocks floating in the solar nebula. They must have come from inside larger objects, the asteroids, where the weight of overlying rock created enough pressure to obliterate the chondrules.

But more happened inside asteroids than merely squeezing chondrules. In the largest asteroids, heat and pressure got so great that rock could melt and crystals move under the force of gravity. Heavy iron crystals sank toward the center and lighter silicates floated toward the surface. The results were differentiated asteroids with metal cores and rocky mantles and crusts. *(Artist's conception, NASA JSC photo S94-43469)*

Life and Death

Meteorites are the bearers of both life and death. They may have brought the very stuff of life to the early Earth, and wiped out the dinosaurs.



21. The early Earth

Early in the solar system's history, about 4.4 billion years ago, the Earth's surface was a violent, lifeless place. It was covered with active volcanoes and hot lava flows, as in this photo. Primitive meteorites, called carbonaceous chondrites, may have brought water and carbon into this inhospitable world, and so helped set the stage for life. *(Hawaii Volcanoes National Park)*

22. Death of the dinosaurs

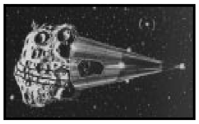
But meteorites have also had devastating effects on life. The dinosaurs were killed 65 million years ago after a huge meteorite hit the Earth. The explosion caused great storms and waves, and the sky was dark for months with dust and ash. The dinosaurs, along with many other animals and plants, were probably killed by the climate changes that followed the explosion. But their deaths permitted other animals to flourish and spread, including primitive mammals. We may owe our very existence as a species to a long-ago meteorite. *(Painting by Don Davis, used with permission)*

23. Comet Shoemaker-Levy 9

Until recently scientists had never seen a really large impact, so much of our knowledge was based on theory. Then in 1993 a comet was discovered heading for Jupiter. That planet's immense gravity had torn the comet into more than 20 fragments, which were lined up and heading for Jupiter at over 60 km/sec! In the summer of 1994 one fragment after another smashed into the planet, producing huge explosions. We saw, from a safe distance, the kind of massive impacts that have scarred all of the planets, including Earth. *(Photomosaic, Space Telescope Science Institute)*

What good are they?

Our studies of meteorites suggest that asteroids may become the sources of vital raw materials for future space travelers.



24. Resources: Visiting an asteroid

Today, we look to the future, toward space missions to the asteroids, and eventually to human travel to other planets. Guided by the meteorites that fall to Earth, we might mine the asteroids for oxygen, water or metal. We might also search them for more clues to our origins, as we continue to explore the solar system. *(Painting by Dennis Davidson, used with permission)*

25. Exploring Mars

One day humans will explore the surface of Mars and other worlds farther still from Earth. In order to stay for long periods, we will have to learn to "live off the land," just like the pioneers of old. Resources from the planets and asteroids may provide the key to humanity's exploration across the solar system. *(Painting by Pat Rawlings, NASA JSC photo S94-26680)*

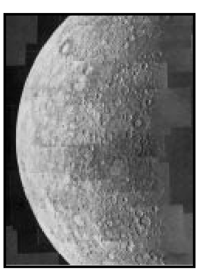
Part 2. Impact Craters

(may be used with Lessons 6 and 7)

One of the key things we've learned from space exploration is that craters are among the most important geologic features in our solar system. Almost everywhere spacecraft have traveled they have sent back pictures of craters.

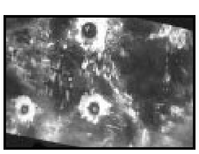
26. The Moon

The Moon is covered with craters in a wide range of sizes. You can see a few of the largest with your naked eyes, and many more with binoculars. *(NASA JSC photo AS17-152-23311)*



27. Mercury

The planet Mercury, as seen by the Mariner 10 spacecraft, is also covered with craters. Mercury has essentially no atmosphere, and its cratered surface looks much like that of the Moon. *(Photomosaic, NASA Jet Propulsion Laboratory)*



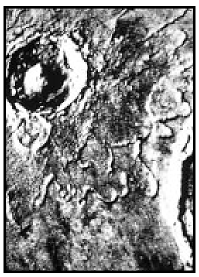
28. Venus

The surface of Venus has craters too. Venus has a thick atmosphere which destroys many impacting bodies before they reach the surface. Some do make it through, though, to form craters. The largest crater in this picture is 60 km across.

We cannot see the surface of Venus directly, since the atmosphere is filled with thick clouds. This picture was made from radar data, taken by the Magellan spacecraft. Radar images have no color. The colors in this picture were made by a computer, to make it easier to pick out the craters and other features. *(Photomosaic, NASA Jet Propulsion Laboratory)*

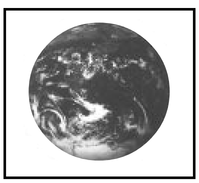
29. Mars

Impact craters are also visible on the planet Mars. The thin martian atmosphere does not do much to slow an impacting body from space. *(Photomosaic, U. S. Geological Survey)*



30. Mars crater

This photo, taken by the Viking spacecraft, shows a relatively fresh crater on the martian northern plains. If craters are so common in the solar system, why are they so rare on Earth? *(NASA Jet Propulsion Laboratory)*

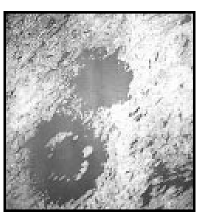


31. Earth

The Earth has suffered many impacts over its history, just like the other planets. However, Earth's surface is constantly being changed by erosion. Water, ice, wind, and plate tectonics have destroyed most of the craters that Earth once had. Only relatively young or quite large craters exist on Earth today. *(NASA JSC photo AS17-148-22727)*

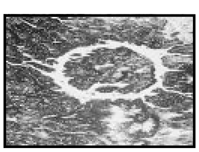
6. Meteor Crater, Arizona (repeat)

The freshest impact scar on Earth, Meteor Crater in Arizona, is only 50,000 years old. Earlier in its history our planet suffered many large impacts. *(NASA JSC photo S78-33855)* **Note:** Slide was reversed in production. Flip horizontally for showing.



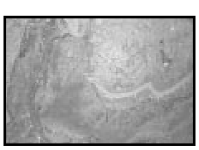
32. Clearwater Lakes, Canada

The craters of some impacts can still be seen, often as round lakes like the twin Clearwater Lakes in Canada. These two craters, 32 and 22 km across, are both 290 million years old. *(NASA JSC photo 61A-35-86)*



33. Manicouagan, Canada

Manicouagan crater in Canada is a ring-shaped lake nearly 70 km across. In the 212 million years since it was formed, the crater has been deeply eroded. *(NASA JSC photo S09-48-3139)*



34. Spider Crater, Australia

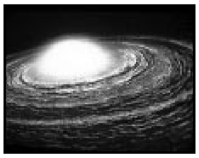
Some craters have been almost completely eroded away. Spider Crater in Australia, 13 km across, is over 600 million years old. It is barely recognizable as an impact structure. *(NASA JSC photo S08-42-2191)*

Part 3. Classification and Formation

(may be used with Lessons 10, 11, and 12)

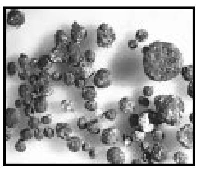
How are they made?

The Noblesville and Sikhote-Alin meteorites are examples of the two major types of meteorites. Noblesville is a stone meteorite, the most common type, while Sikhote-Alin is a rarer iron meteorite.



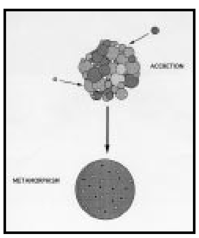
19. Solar nebula (repeat)

Most meteorites are very old, as old as the solar system (4.6 billion years). Because meteorites haven't changed much since then, they are the best clues we have to the origin and history of the solar system and of the Earth. *(Painting by Don Dixon, NASA JSC photo S76-25001)*



35. Chondrules

Chondrules are the primitive building blocks of the solar system. In the early solar nebula they came together to form larger and larger masses — the forerunners of asteroids and planets. The largest chondrule in this picture is less than 1 cm across. Most chondrules are so small that it is difficult to learn much about them without a microscope. *(Photo by Allan Treiman, NASA JSC photo S93-33279)*

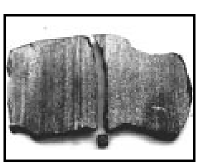


36. Accretion and metamorphism

In the early solar nebula chondrules came together to form larger and larger masses. The process is called accretion. Some very primitive meteorites are just masses of chondrules stuck together. In most meteorites, though, the chondrules have been partially or totally destroyed by metamorphism. To destroy chondrules takes a lot of pressure and cooking time, so much that these meteorites could not have been formed as small rocks floating in the solar nebula. They must have come from inside larger objects, the asteroids, where the weight of overlying rock created enough pressure to obliterate the chondrules. *(Artist's conception)*

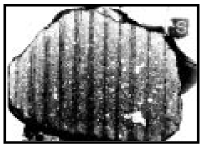
16. Stony meteorite (repeat)

The two main types of stony meteorites are chondrites and achondrites. Noblesville is a chondrite, the most common variety. Chondrites like this one are made up of hundreds or thousands of small spherical chondrules. *(Photo by Cecilia Satterwhite, NASA JSC photo S94-44343)*



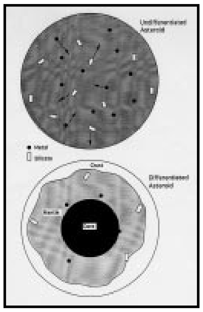
37. Chondrite

In some chondrites the chondrules are separated by patches of iron metal. Different types of chondrite meteorites have different amounts of metal and have been heated to varying degrees. Chondrites are called primitive because they formed early in solar system history and haven't changed since then. *(Photo by Roberta Score, NASA JSC photo S93-33203)*



38. Carbonaceous chondrite

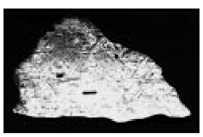
Carbonaceous chondrite meteorites are black because they contain carbon, like soot or pencil lead. They also contain water and complex carbon compounds (amino acids) like those found in living things. In addition, carbonaceous chondrites contain mineral grains even older than the solar system - pieces of dust that formed long ago around far distant stars. *(Photo by Rene Martinez, NASA JSC photo S86-29989)*



20. Differentiation (repeat)

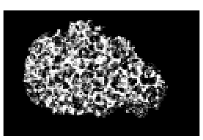
This diagram shows an undifferentiated stony asteroid which was heated enough for the inside to melt. Crystals in the melt are starting to move under the force of gravity. In an asteroid (or a planet), the densest material is iron metal, shown as black dots, which sinks toward the center. The lightest minerals, silicates called feldspar, float toward the surface. The remaining material solidifies to form the minerals olivine and pyroxene, which stay in the middle.

If this separation process goes to completion before the melted rock solidifies, a differentiated asteroid or planet results. The core is metal, the mantle is olivine and pyroxene, and the crust is rich in feldspar. The Earth and Moon differentiated just this way, and scientists believe the other rocky planets and many of the larger asteroids also differentiated. *(Artist's conception, NASA JSC photo S94-43469)*



17. Iron meteorite (repeat)

Iron meteorites probably formed in the cores of asteroids, and were released when the asteroids were shattered by impacts. Inside, many iron meteorites are made of criss-crossing intergrown crystals of two iron-nickel minerals. The two types of crystals in this sample are several centimeters wide. The sizes and shapes of the crystals suggest that they cooled down so slowly, a few degrees each million years, that they must have been inside large asteroids. *(Photo by Carl Allen, NASA JSC photo S94-43470)*

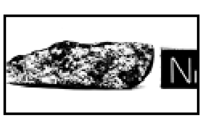


18. Stony-iron meteorite (repeat)

Stony-iron meteorites formed at the boundary between the core and the mantle of an asteroid. The iron metal was part of the core, and the greenish rounded grains are olivine, part of the asteroid's mantle. *(Photo by James Holder, NASA JSC photo S94-44546)*

39. Volcanism

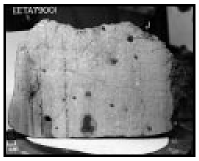
Action on an asteroid may not end with differentiation. Some asteroids got so hot that they melted inside and spewed lava onto their surfaces, just like this lava flow on Earth. The lava hardens to a rock called basalt. Some basalts from asteroids fall to Earth as meteorites. *(Photo by Carl Allen, NASA JSC photo S94-44543)*



40. Achondrite meteorite

Achondrites are a class of stony meteorites, so named because they do not contain chondrules. They look like igneous (lava) rocks on Earth. These achondrites formed during volcanic eruptions on planets or asteroids. Other achondrite meteorites are breccias, mixtures of rock fragments broken and reassembled by meteorite impacts. *(Photo by Roberta Score, NASA JSC photo S81-33267)*

41. Meteorite from the Moon
This is a meteorite which was found a few years ago in Antarctica. It is made mostly of broken pieces of feldspar. Scientific studies have proven that this meteorite and a few others like it are from the Moon, not from asteroids. They were blasted off the Moon by other meteorite impacts there, and quickly traveled the short distance from the Moon to the Earth. *(Photo by Roberta Score, NASA JSC photo S82-35865)*



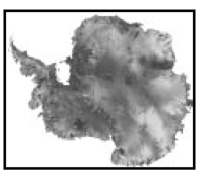
42. Meteorite from Mars
The planet Mars comes within 56 million km from Earth, or over 150 times as far away as the Moon. Amazingly, a few of the meteorites found on Earth actually came from Mars.

This meteorite, found in Antarctica, contains traces of Martian atmosphere. The Martian atmosphere gas is in black veins and pockets of glass, which you can see on this cut surface. The glass probably formed when another meteorite hit Mars and partly melted these rocks. The pressure of the impact then squeezed some Martian atmosphere into the glass before it cooled. But the rest of this meteorite looks just like basalt rocks from the Earth. *(Photo by Roberta Score, NASA JSC photo S80-37631)*

Part 4. Meteorites from Antarctica

(May be used with Lesson 18)

Today much of the search for meteorites is concentrated in Antarctica. Teams of scientists bring back hundreds of samples each year. These rocks from space are classified and distributed to researchers for careful scientific study.



43. Antarctica
The frozen continent of Antarctica has proven to be the best place on Earth to find meteorites. The meteorites fall onto glacial ice and are carried along until the glacier encounters a mountain range or other barrier. The ice then stops and eventually evaporates, leaving the meteorites behind. *(Photomosaic, National Oceanic and Atmospheric Administration)*

44. Tents
Meteorite collecting trips to Antarctica are not easy. Teams live in polar tents far from their permanent bases for months at a time. They travel by helicopter and snowmobile. In bad weather team members may be confined to their tents for days, but on good days they are out finding meteorites. *(Photo by Everett Gibson, NASA JSC photo S80-36583)*

8. Meteorite in Antarctica (repeat)
During the last 20 years, U.S. Antarctic expeditions have collected over 8,000 meteorite fragments. Each sample is photographed, given a number, and carefully packaged. Every effort is made to prevent contamination, which would make meteorites less useful for scientific studies. *(Photo by John Annexstad, NASA JSC photo S80-35602)*

45. Glove box
Meteorites collected in Antarctica by U.S. expeditions are brought to this special clean lab at the NASA Johnson Space Center in Houston, Texas for initial study. Experienced curators describe and classify them. The meteorites are kept in glove boxes filled with nitrogen gas to keep them from rusting or otherwise changing. *(NASA JSC photo S78-32478)*

46. Chipping
The curators are responsible for distributing meteorite samples to scientists around the world. Here a piece of a small meteorite is being chipped off for scientific study. *(NASA JSC photo S78-32471)*

47. Scanning Electron Microscope
The meteorites are examined with many sophisticated tools. One of them is the scanning electron microscope. This microscope can take pictures with magnifications of over 100,000 times and determine the chemical compositions of bits of material too small to be seen with the naked eye. *(NASA JSC photo S92-48880)*

48. Computer
Computers are used everywhere in scientific laboratories. Some are used to control instruments and some to collect data. Scientists also use computers to create the diagrams and write the reports that tell others of their results. *(NASA JSC photo S89-35189)*