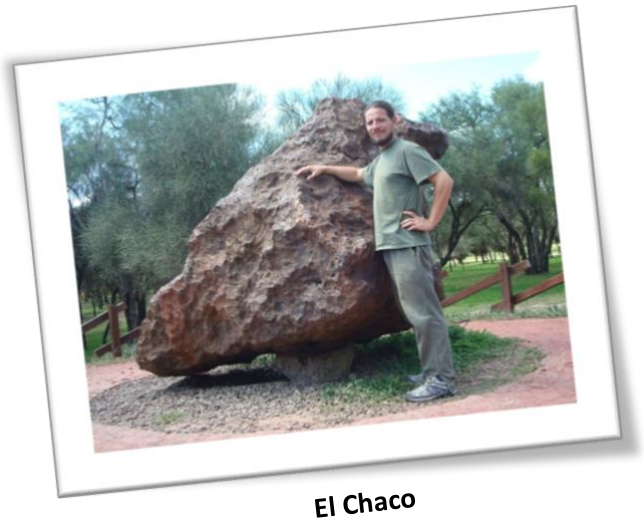
Iron and Stone Meteorites and Activity

Iron Meteorite Facts



El Chaco

The iron meteorite in this picture was found in a region called **Campo del Cielo** (meaning 'Field of the Sky') in Argentina.
This was an enormous meteorite that landed on Earth around **4,500 years ago** (about the time the pyramids were being built in Egypt). Because of how much of the Earth's surface is covered in water, most meteorites crash into the ocean – meaning they cannot be recovered for investigation.

The original meteorite body is estimated to have been approximately 4 metres in diameter and weighed over 100 tonnes. It broke into thousands of pieces when it was slowed by the atmosphere and these hit the ground, almost at a right angle, at a speed of roughly 14,000 Km/hour.

The result was a shower of meteorites ranging in size from small stones weighing just a few grams to much rarer big pieces of tens, and sometimes even hundreds of kilograms. A few specimens – most still held in Argentina – have masses exceeding one tonne. The largest specimen is a huge rock called 'El Chaco', weighing in at 37 tonnes. This is the second largest whole meteorite ever to have landed on Earth. During impact, more than 20 craters were formed in a large area of over 1,350 square kilometres. The largest crater is about 100 metres in diameter.

The fragments of this meteorite are approximately **4.5 billion years old** and came **from between Mars and Jupiter** where a planet (called Phaeton) tried to form during the formation of our solar system. However, this planet broke apart from the pull of the neighbouring planets, leaving debris in this area forming an asteroid belt. It is from here that we get the majority of our meteorites on Earth.

en pattern

These remnants are comprised of **approximately 90% iron and 10% nickel**. Because they have a high iron content, they are **magnetic**. Before the development of smelting in the Iron Age, 'meteoric iron' was one of the sources of iron used by humans because of its malleability.

If you were to cut through one of these meteorites, you would find a beautiful pattern caused by the molten metal cooling very slowly in space. Because there is no conduction or convection in a vacuum, the metal can only cool via radiation and this takes a very long time. The crystalline structure is referred to as the **Widmanstätten pattern** and is created by the molten metal cooling at a rate of approximately 1°C per million years. Iron meteorites are quite dense so account for a large amount of the mass of

all known meteorites and are more resistant to the heat of atmospheric entry, so we typically find larger samples of these.

Stony Meteorite Facts

Stony meteorites are the **most abundant type of meteorite**, falling into two categories – **chondrites** and **achondrites**.

Chondrites

Chondrites are physically and chemically the most primitive meteorites in our solar system. They appear to be mostly collections of material that formed in the solar nebula either prior to or during planet formation. They also contain some material that **predates the formation of our solar system**. Most chondrites have been altered by either heat or water when they were part of their parent asteroids, but none have experienced any significant melting.

Chondrites, in general, are any stony meteorite, characterised by the **presence of chondrules**. These are roughly spherical inclusions made up of silicates, metal and sulphide. They appear to have formed as molten droplets at high temperatures in the early solar nebula. The chondrules are set in a fine grained matrix of rock.

Chondrites are the **most abundant meteorite class**, constituting more than 85% of meteorite falls. Like most meteorites, chondrites originated in the asteroid belt between Mars and Jupiter. Chondrites **formed about 4.56 billion years ago** as part of the formation of their parent asteroids and have remained relatively unchanged since the formation of the solar system.

Achondrites

Achondrites, on the other hand, were all **produced by the melting of their parent bodies**. Although most achondrites are fragments of asteroids, a few come from the Moon or Mars.

An achondrite is any stony meteorite containing **no chondrules** (see above) and constitute only about 1 in every 25 known meteorite falls.

Group Activity

Print out the list of facts about the above Iron and Stone meteorite types, which can be found at the end of the document and give a fact to each student. Specify **four** areas in the room that the students can stand in which represent Iron, Chondrites, Achondrites and All Meteorites. The students then go to whichever area they think is the correct one for their fact. Leaders can then check which students are in each section and make corrections if necessary. Make sure to shuffle all 18 facts cards well – if your group is larger than this, consider printing multiple copies or simply having students work in pairs, and have them swap cards and do multiple rounds.

Iron Facts	Chondrite Facts	Achondrite Facts	Meteorites in general
I am magnetic so can be found even if buried under sand.	I am the oldest type of meteorite.	I am 1 in every 25 meteorites discovered.	I land at speeds of over 10,000 km/h.
I have a beautiful pattern inside.	I contain chondrules.	I was produced by the melting of a larger body of rock.	I land most often in water.
I was an early source of metal for humans.	I contain material older than the Solar system	I occasionally come from the Moon or Mars.	I came from the area between Mars and Jupiter.
I am more likely to be found in larger pieces.	I have been warped by heat but not melted.	I am stony but contain no chondrules.	
	I contain a matrix of small rocks.		
	I formed as a molten drop.		
	I am the most common type of meteorite.		