



### LW2 Cosmic Forensics: Can the Sky Fall on Our Heads?

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**Learning Overview:** The goal of this presentation is to familiarize attendees with the role of forensic sciences in geosciences and space research.

**Impact on the Forensic Science Community:** This presentation will impact the forensic scientific community by providing useful information to those engaged in the study of extraterrestrial materials (i.e., meteorites, micrometeorites, and interplanetary dust particles) in a judicial contest. This presentation will focus primarily on meteorites, which have been documented to strike structures and objects or injure human beings.

Despite having been the subject of mineralogical, chemical, astronomical, and even archeological studies, meteorites have remained a riddle for the human mind. If reason has succeeded over the centuries to make most of their mysteries intelligible, the fascination of these “stones fallen from the sky” nevertheless continues to pose new questions.

The National Aeronautics and Space Administration (NASA) has released the Near Earth Object Program, which tells us that approximately 100 tons of “fairly small natural objects,” mainly rock fragments and dust particles, fall onto the Earth from interplanetary space every day. As they enter the atmosphere at more than 62,000 miles per hour, they heat up and catch fire, forming a luminous trail. They are then called meteors (or shooting stars). Although most meteors burn up completely before they reach the ground, some of them collide with the Earth’s surface. A meteor that does not burn up as it crosses the atmosphere becomes a meteorite. It partly disintegrates on hitting the ground, and its fragments can weigh anything from a few ounces to a couple of tons and spread over several miles. Laboratory, astronomical, and theoretical studies have shown that meteorites are products of collisions that occur within the asteroid belt between approximately 2.1 and 3.3 Astronomical Units (AU) from the Sun (one AU is the average distance from Earth to the Sun, approximately 93 million miles). It is within this region that strong gravitational perturbations by the planets, especially Jupiter, can put meteoroids (the name given to bodies of matter moving in space before they enter Earth’s atmosphere) into Earth-crossing orbits. However, not all meteoroids are formed in the asteroid belt. A few may be the remains of cometary nuclei that originated outside this region, and fewer than 1% of meteorites are recognized to be samples of debris from the surface of the Moon and Mars that have been ejected by impacts.

This presentation is divided into two parts. In the first part, attendees will learn how to identify a meteorite and the phenomenon of the black market in meteorites, which is as organized as any drug trade and just as illegal, will be discussed.

Subsequently, this presentation will present an analysis of 53 meteorites that, from the early 19<sup>th</sup> century to 2018, have hit artificial structures, animals, and people. Although scholars have not been able to confirm the accident nor the fall, on January 16, 1825, scientific memories reported the first “death by meteorite”: a man was killed and a woman injured during a meteorite fall in Oriang, India. Two years later, on February 16, 1827, a man was wounded severely in the arm by an ordinary chondrite meteorite that fell in Mhow, India. On November 11, 1836, chronicles reported the first animal to be killed. It was a cow hit by a shower of meteorites in Macau, Brazil. On August 8, 1863, a 5.4-Kg enstatite chondrite penetrated the roof and floor of a building in Pillistfer, Estonia. On September 15, 2007, a fireball was witnessed landing near Carancas, Peru. Villagers were sickened by the fumes released from an underground water supply tainted with arsenic after the impact. On February 15, 2013, a meteorite exploded above Chelyabinsk, Russia, injuring 1,200 people and causing \$33 million in damage.

In conclusion, particular attention will be devoted to the case of Ann Hodges, who was hit by a meteorite that crashed through the roof of her home and smashed into her hip, leaving a pineapple-shaped bruise, on November 30, 1954, in Sylacauga, AL. The event caused a worldwide media sensation and a year-long legal battle. The meteorite, which weighs approximately 3.85kg, is on permanent display at the Alabama Museum of Natural History.

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### Case Report, Cosmic Forensics, Meteorite