A Delicate Balance: 
Asteroidal Impacts and their Consequences

Jon M. Friedrich

Department of Chemistry, Fordham University
Department of Earth and Planetary Sciences, American Museum of Natural History

24 March 2010
The Earth is under constant bombardment by material from space.
Rocks from space

Every day, about 500 tons of dust and rock from space collides with planet Earth. Much of this space debris burns up as it enters the atmosphere, producing streaks of light called shooting stars. However, particles smaller than a millimeter wide can sometimes slip through the air without getting hot enough to burn. These micrometeorites float through the sky as dust, and fall to the ground in rain. With a powerful magnet—and a bit of luck—you stand a chance of finding one.

**WHAT YOU WILL NEED**

- Magnet
- Paper cup
- String
- Sheet of white paper
- Magnifying glass
- Tweezers
- Microscope
- Glass slide

1. Place a powerful magnet in a paper cup and tie a loop of string to the top of the cup to make a micrometeorite collector. Take the collector outside on a dry day, and gently tap it over areas of ground that are dry but that do get wet after rain, and seldom disturbed by people or vehicles. Good places to try include the ground around downsprouts and undisturbed lawns.

2. When black specks appear on the bottom of the cup, take it indoors and place the cup on some clean white paper. Remove the magnet and tap the cup to shake off the specks.

3. Use a magnifying glass and tweezers to pick out particles that look spherical and less than about 1/8 in (half a millimeter) wide. These could be micrometeorites made of iron or nickel, which are magnetic. Particles that are not spherical will be flecks of iron from other sources.

4. If you have a microscope, put the best particles on a glass slide and examine them. Micrometeorites often look smooth because the surface melts as they enter Earth's atmosphere. You can also use a microscope to search for micrometeorites in the dust that appears on cars after rain. This dust comes from high in the sky and contains desert sand and volcanic ash, which may have traveled thousands of miles, as well as micrometeorites.

**WHAT IS A METEORITE?**

Space rocks that land on Earth's surface are called meteorites. Most are fragments of broken asteroids (rocked rocks) that orbit the Sun; some made of iron come from the cores of asteroids. Only about 500 meteorites bigger than a basket ball hit Earth each year, and most of these end up in the sea.
Midnight (6:39 UT) 6 October 2008 - Arizona

*Impact* in less than 24 hours! (2:46 UT, 7 October 2008)

Image Credit: Richard Kowalski and Ed Beshore, Mount Lemmon Survey (Catalina Sky Survey)
The entry path of 2009 TC$_3$ and the Almahata Sitta meteorites.
The long-lasting persistent train after the impact of 2008 TC₃ over the Sudanese skies; Mohamed Elhassan Abdelatif Mahir (Noub NGO), Dr. Muawia H. Shaddad (Univ. Khartoum), Dr. Peter Jenniskens (SETI Institute/NASA Ames)
Almahata Sitta
4 m (weak) rocky asteroid
no crater
atmospheric detonation
→ sample return mission!
30 m iron asteroid
1.2 km crater
10-20 MT of TNT (large H bomb)
global catastrophe
tsunamis, widespread devastation, climate change
atmospheric explosion or small crater

Mean Impact Interval ($T_{mean}$, Whole Earth, years)

projectile diameter (m)
Chicxulub crater
Yucatán peninsula
65 million years ago

10 km stony asteroid
180 km (110 mile) crater
100,000,000 MT of TNT
Chicxulub crater
Yucatán peninsula

K-T boundary (Cretaceous-Tertiary boundary)
[Cretaceous–Paleogene (K–Pg) event]
Survival in the first few hours of the Cenozoic: what would it have been like to be on the Earth 65 million years ago?
A Ride With The Earth

An animation centered on Earth showing the known objects that have approached to within 20 million km between July 2007 and June 2008. See the Animations Page on the MPC website for a description of the symbols used in this animation.