Comets are time capsules holding clues to the formation and evolution of our solar system. Comets are made of icy and dust particles from the solar system’s earliest and coldest period 4.5 to 5 billion years ago. Deep Impact is a NASA Discovery Mission designed to tell the second story to astronomers by sending a spacecraft to the surface of a comet and reveal some of the secrets stored in a comet’s interior.

**What is a Comet?**

Comets have three kinds of tails, each composed of different particles: dust, ions, and a plasma gas cloud. The passing of a nearby star can give a comet a gravitational push that sends it on a new path. Comets are frozen material left over from the formation of the solar system. Most comets are in the far reaches of the solar system near regions known as the Kuiper Belt and Oort Cloud. In the outer solar system, a comet just 100 kilometers across could be as far as 100,000 kilometers in all directions. In the vacuum of space, tails form from comet dust. Comets have three kinds of tails, each composed of different particles: dust, ions (charged gases), and neutral atoms. A comet’s tail will always point away from the Sun in the direction of the solar wind. On its trip back to the outer regions of the solar system, the tail will precede the comet. Some comets visit the Sun as little as five years. Other comets return to the outer reaches of the solar system and only approach the Sun every few centuries. Still others pass through only once, never to return.

**The Mission**

On July 4, 2005, the Deep Impact spacecraft will impact Comet Tempel 1 with a 370 kg (810 pound) mass, producing a crater ranging in size from a house to a football stadium and two to seven stories deep. The impact will speed up and dust from the surface of the comet and reveal fresh material beneath. The impact will also create an enormous amount of heat as the hot and ejected debris flows into the vacuum of space, a dramatic brightening will be produced that will fade slowly over time. The impact will be visible using telescopes. Scientists will analyze these images to understand what the comet is made of. The size, shape, and formation of the crater should tell us about the strength of the comet’s surface and its interior.

**What We Know**

Comets are frozen material left over from the formation of the solar system. What are the basic properties of a comet nucleus and its interior? Where did comets form in relation to the Sun? What are the basic physical properties of comet comas? How do comets evolve? What is the composition of a primordial ice in comets? What's Deep Inside a Comet?

**What We Want to Know**

How do comets evolve? What happens to them over time? How do comets form in relation to the Sun? What is the chemical composition of the interior of comets? What are the basic properties of a comet nucleus and its interior?

**Excavating Cratering**

The Deep Impact mission is to excavate a crater 25 m deep on the comet Tempel 1. The major question facing the team of astronomers, engineers, and other scientists assembled for the mission is exactly how do we make a crater on a comet? This activity invites you to explore the crater.

**Deep Impact’s oribital path to encounter Comet Tempel 1**

**Impact**

Early in July 2005 the flyby spacecraft will point precision telescopes at the comet and release the impactor on a course to hit the comet’s sunlit side. Twenty-four hours later, thousands of people watching from Earth, the impactor will hit the comet.

**Analysis**

Collecting Valuable Information

The flyby spacecraft, after releasing the impactor, will divert to a new path allowing it to pass approximately 500 km (300 miles) from the comet. From this distance, the flyby will record data about the impact, the ejected material blasted from the interior, and the structure and composition of the comet’s interior. The flyby will then pass through the comet’s coma, turn itself to look at the comet again, and begin its journey back to Earth. The impactor will hit the side of the other side of the nucleus—all the while observing changes in the comet.

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