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Science on the Edge of our Solar System[1]: Discovery Missions (DVD) Teacher Notes

This is a nice DVD that introduces the students to the explorations being conducted by NASA's Discovery missions program. To maximize attention distribute worksheet prior to viewing and say something to the effect that they will be tested on the material. The material is slightly outdated so in the answers in the teacher's notes there is updated information from the NASA website to explain a little more about the status of each of these missions. The video run time is 23 minutes.

Answers to the questions:

1) What is Discovery's main objective? The main objective is to enhance our understanding of the Solar System by exploring the planets, their moons, and small bodies such as comets and asteroids.

2) How many discovery Missions are there? 10

3) How large are asteroids? From the size of pebbles to 1,000 km wide.

4) Describe each of the 10 Discovery missions.:

(1) NEAR: On February 17, 1996, NEAR was the first Discovery Program spacecraft to be launched and it became the first ever to orbit and land on an asteroid. Utilizing six highly specialized instruments to gather data about its primary target, asteroid 433 Eros, the NEAR mission was designed to answer many fundamental questions about the nature and origin of asteroids and comets

(2) DAWN: The Dawn mission will undertake a journey in both space and time by traveling to the two oldest and most massive asteroids in our solar system, Vesta and Ceres. By observing both minor planets with the same set of instruments, Dawn will provide new answers to questions about the formation and evolution of the early solar system.

(3) STARDUST: Launched on February 7, 1999, Stardust is the first space mission dedicated solely to studying a comet. For the first time ever, comet dust and interstellar dust particles will be collected during a close encounter with Comet Wild 2 and returned back to Earth for analysis by scientists worldwide.

[1] http://discovery.nasa.gov/education.html: Unlocking the Mysteries: Science on the Edge of our Solar System, NASA.

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(4) CONTOUR: The Comet Nucleus Tour, or CONTOUR, mission launched from Cape Canaveral on July 3, 2002. Six weeks later, on August 15, contact with the spacecraft was lost after a planned maneuver that was intended to propel it out of Earth orbit and into its comet-chasing solar orbit. Limited ground-based evidence at the time suggested the spacecraft split into several pieces. Attempts to contact CONTOUR were made through December 20, 2002, when NASA and The Johns Hopkins University Applied Physics Laboratory concluded the spacecraft was lost.

(5) DEEP IMPACT: The Deep Impact mission will send a large copper projectile into the path of a comet. The resulting impact will create a huge crater and reveal never before seen materials with clues to the internal composition and structure of a comet.

(6) LUNAR PROSPECTOR: Lunar Prospector, the third Discovery mission, launched on January 6, 1998, and was successfully placed into orbit 63 miles above the lunar surface five days later. The studies conducted by the spacecraft and its five instruments were designed to provide insights into lunar origin and evolution and determine whether or not water ice is present in the Moon's polar regions.

(7) GENESIS: What is the sun made of? Are the Earth and planets made of the same materials? The Genesis mission will send a spacecraft to collect pieces of the sun, called solar wind, that may contain the answers. After its August 8, 2001 launch, the Genesis spacecraft has now journeyed a million miles sunward, unfolded its collectors and begun to "sunbathe" for more than two years, before returning to Earth in September 2004 with its unique cargo. The goal of the mission is to enrich our understanding of the birth and evolution of the planets and all the bodies in our solar system. On September 8, 2004, the sample return canister separated from the spacecraft and entered Earth's atmosphere, heading toward the preplanned entry ellipse in the Utah Test and Training Range. The science canister containing the solar wind particles was transported to a specially constructed clean room at the U.S. Army Dugway Proving Ground in Utah, where team members began the tedious effort to extract the pieces and inventory the contents. Samples will be distributed to scientists to study over the coming months and years.

(8) MARS PATHFINDER: Launched on December 4, 1996, Mars Pathfinder demonstrated a number of innovative, economical, and highly effective approaches to spacecraft and planetary mission design. In addition to the engineering feat of landing on Mars, the mission also served as a demonstration of key technologies and concepts for use in future missions to Mars. The primary objective was to demonstrate a low-cost method of delivering a set of science instruments and a free-ranging rover to the surface of Mars. The rover conducted technology experiments and served as an instrument deployment mechanism.

(9) MESSENGER: The MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) mission is a scientific investigation of the planet Mercury. Understanding Mercury and the forces that have shaped it is fundamental to understanding the evolution of the terrestrial planets. MESSENGER will orbit Mercury for one Earth year following two flybys of that planet. The orbital phase will use the flyby data as a guide to perform a focused scientific investigation designed to answer key questions about Mercury's characteristics and environment. MESSENGER launched on August 3, 2004, aboard a Boeing Delta II rocket from Cape Canaveral Air Force Station, FL. It will return to Earth for a gravity assist a year after liftoff; swing past Venus twice, then fly by Mercury three times before starting a yearlong orbit of the innermost planet in March 2011. MESSENGER's science goals are to provide the first images of

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the entire planet and collect detailed information on the composition and structure of Mercury's crust, its geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials.

(10) KEPLER: Are there other planets, orbiting other stars, with characteristics similar to Earth? The Kepler Mission is designed to find Earth-size planets in orbit around stars like our Sun outside of the solar system. The scientific goal of the Kepler Mission is to explore the structure and diversity of planetary systems, with a special emphasis on the detection of Earth-size planets. It will survey the extended solar neighborhood to detect and characterize hundreds of terrestrial and larger planets in or near the "habitable zone," defined by scientists as the distance from a star where liquid water can exist on a planet's surface. The results will yield a broad understanding of planetary formation, the frequency of formation, the structure of individual planetary systems, and the generic characteristics of stars with terrestrial planets.

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