

Part 1: ID the Planets



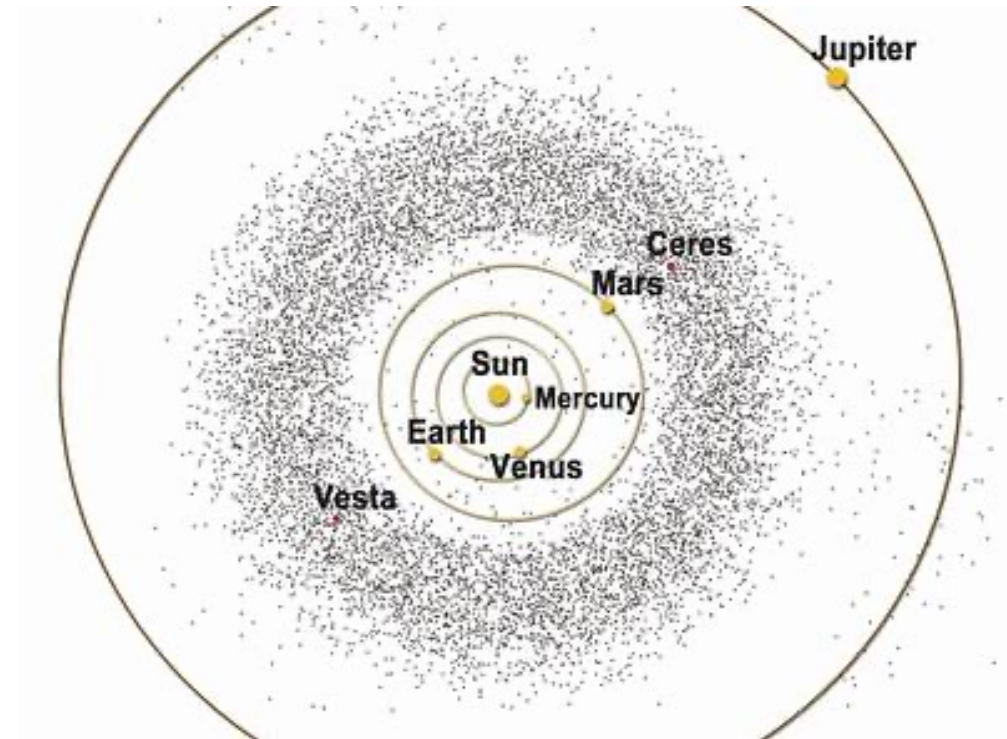
Now Part 2

Planetary Defense Against Asteroids

Why worry about Asteroids?
Stayin' Alive

Asteroids: Rocky remnants from our solar system's formation about 4.6 billion years ago

- MAIN ASTEROID BELT: between Mars & Jupiter
- Diameter: 329 miles to 33 feet and smaller, some with 1-2 small moons
- Total mass of all asteroids: less than our Moon



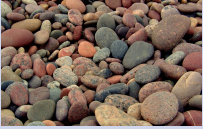


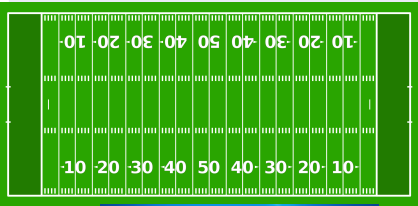

Why do they sometimes leave orbit?

Illustration Of the Asteroid Belt



1,113,527 Known Near Earth Objects

Why Worry About Asteroids?

	Size	Frequency	Result of Impact
	pebbles	100 tons/day	Dust
	20-25 ft	Once/ year	An impressive fireball that burns up before reaching the surface
	75-82 ft	Monthly	Local damage (mostly in ocean)
	300 ft	Every 2,000 years	Significant damage, like an A-Bomb
	2600- 7500 ft	Millions of years	Worldwide effects: The Big One!

“The Big One” threatening Earth's civilization

- **66 million years ago** a 6 mile-wide asteroid hit Earth: Chicxulub crater under the Yucatán Peninsula
 - Debris blocked sunshine for years, which killed plant life
 - 75% of plant and animal species on Earth became extinct
- **In 1908** a meteor 200 feet across exploded over Siberia.
 - The shock wave leveled 800 square miles of forest.
 - Greenwich is 50 sq miles

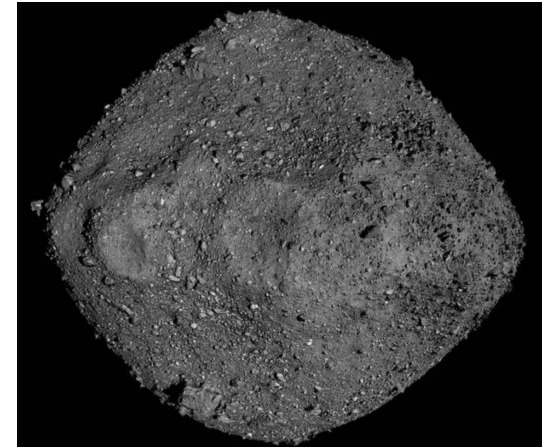
Goodbye Dinosaurs!

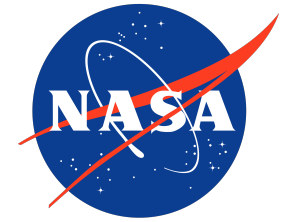


Are we overdue?

Ahead?

- Bennu:
 - Diameter: 1,614 feet Size: Pyramid of Giza
 - a 1/2700 chance of impacting Earth between 2175 and 2195
- Toutatis:
 - Diameter: 3 miles The largest known potential hazard
 - December 2012: passed Earth within about 18 lunar distances
- But...
 - **1,113,527 NEO known; 27,000 worrisome, finding 2,000 per year!**
 - **17,000 near-Earth asteroids 460 feet or larger still to be found**





NASA's Planetary Defense Program

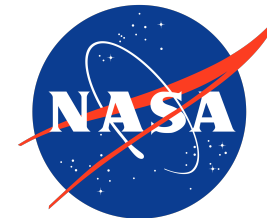
- Detect, track and warn of potential asteroid or comet impacts with Earth
- Plan mitigation
- Implement defense

Two Methods of Defense: Redirection or Nuclear Bomb

- If aim error = many fragments
- Need > 2-12 months before impact

NASA's budget for planetary defense is \$150 million a year

How Do We Find Potential Impacts?



- Detect

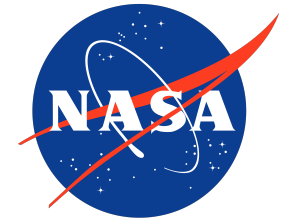
- The Wide-field Infrared Survey Explorer space telescope (NEOWISE)
- The Infrared Telescope Facility (IRTF) on Mauna Kea in Hawaii
- University telescope and radar sites

- Archive

- The Minor Planet Center collects orbit data

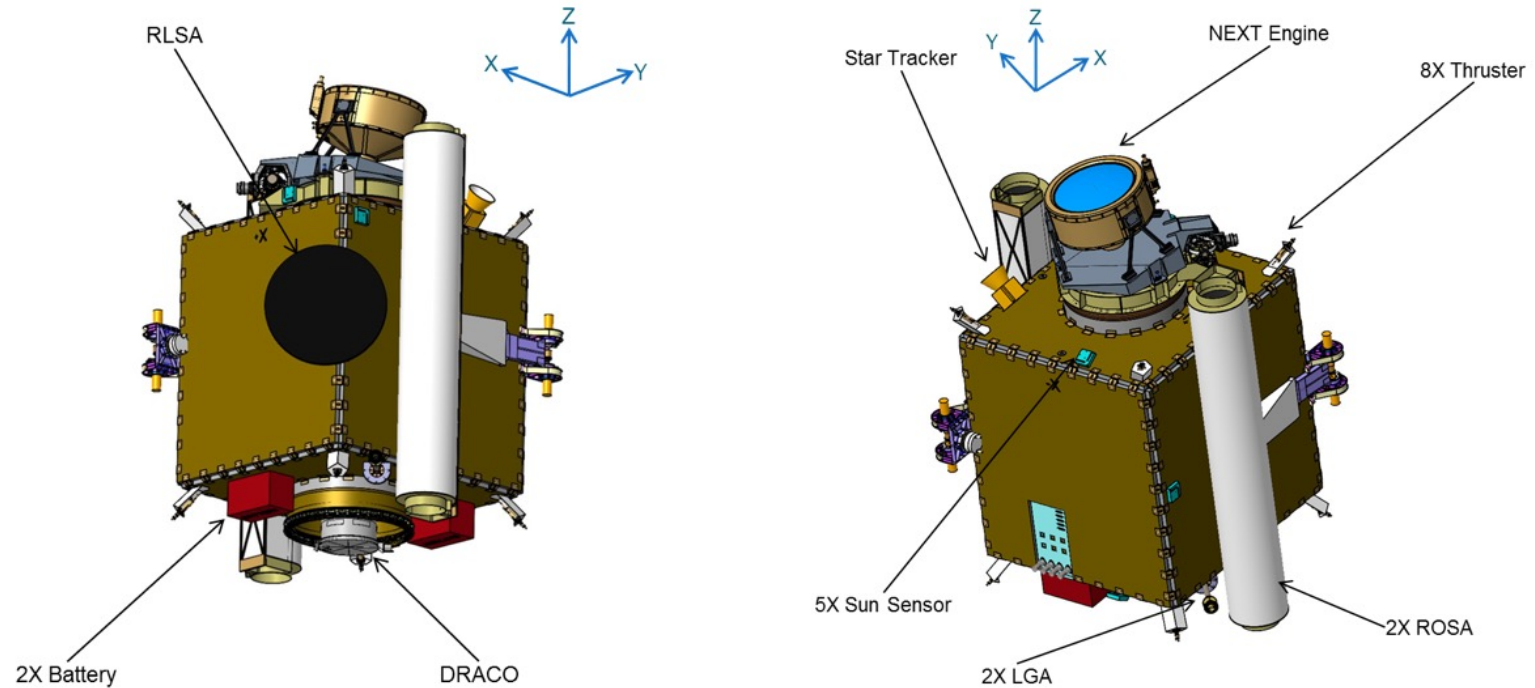
- Analyze

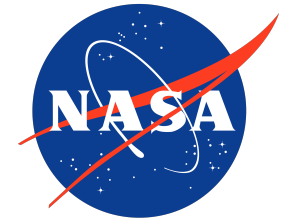
- Center for Near-Earth Object Studies computes high-precision orbit paths for NEOs to predict impact



NASA's Planetary Defense Double Asteroid Redirection Test Mission: DART

- The first demonstration of the **kinetic impactor** technique to deflect an asteroid enough to prevent impact
- Launched November 24, 2021
- Travel 6.5 million miles
- One year in transit





Double Asteroid Redirection Test (DART)

- Target: Dimorphos- moonlet of a double asteroid, 500 feet across
- NOT A THREAT TO EARTH
- Launched Nov. 24 by NASA
- 11 years to prepare this test



Where do you aim?

Hit and redirect a rotating asteroid at
15,000 Miles per hour 6.5 MM miles away?



11 years! Can we react in time for the next Big One?

Whose job is it?