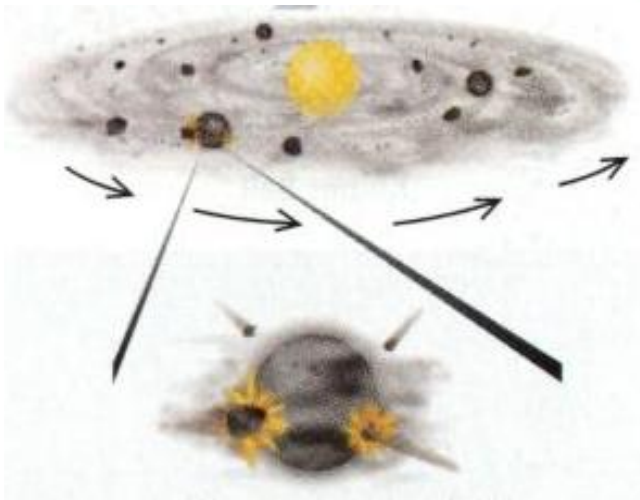
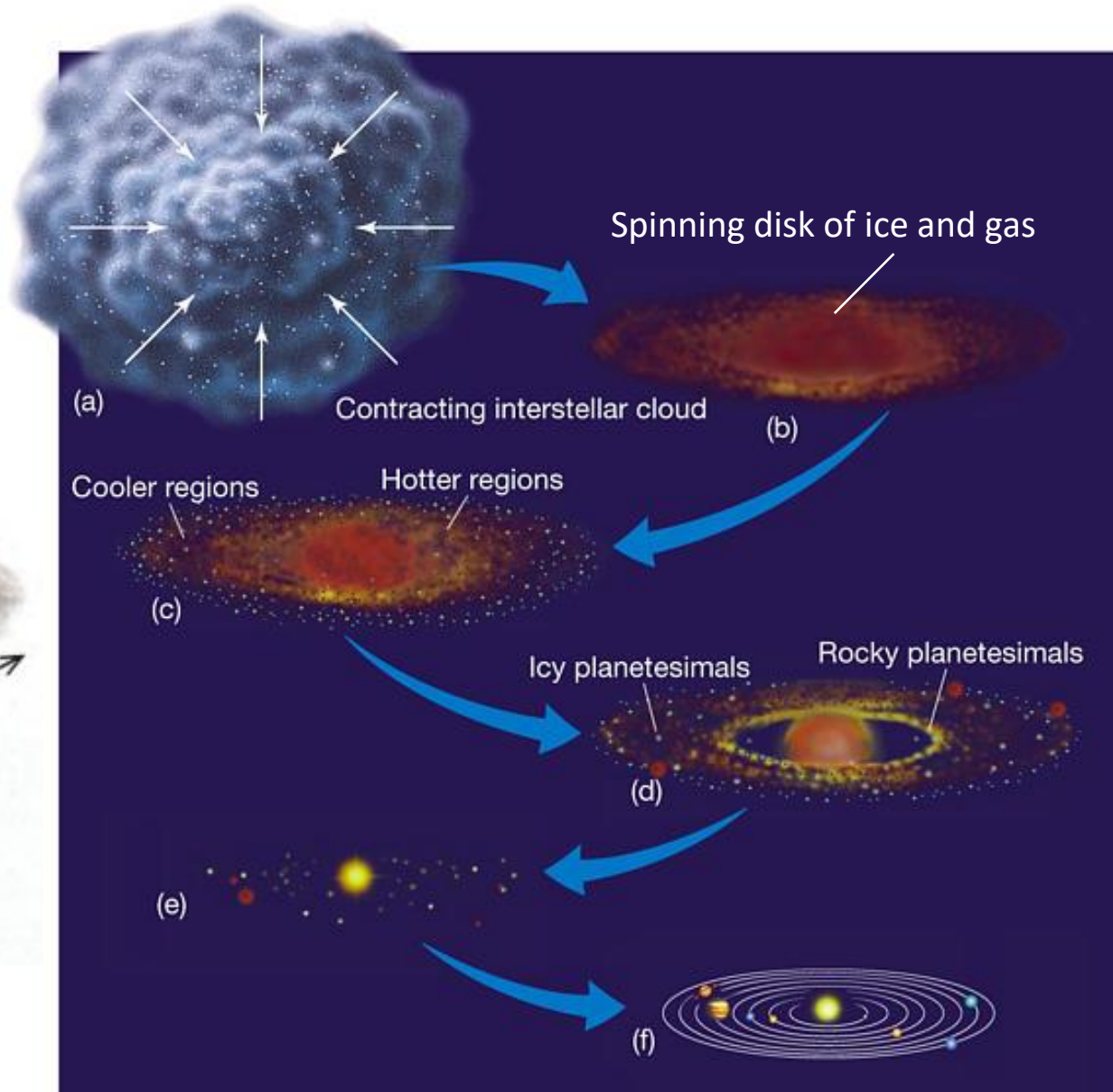


# Solar System Formation

The Earth and other planets of the Solar System were formed as a result of *planetesimals* colliding and sticking together.



**Leftovers?**



# Definitions

**Asteroid:** A relatively small (>10 m size), inactive, **rocky body** orbiting the Sun. Some may be called “minor planets”.

**Comet:** A relatively small, at times active, **icy object** whose ices can vaporize in sunlight forming an atmosphere (*coma*) of dust and gas and, sometimes, a tail of dust and/or gas.

**Meteoroid:** A small particle from a comet or asteroid that is on a collision course with Earth.

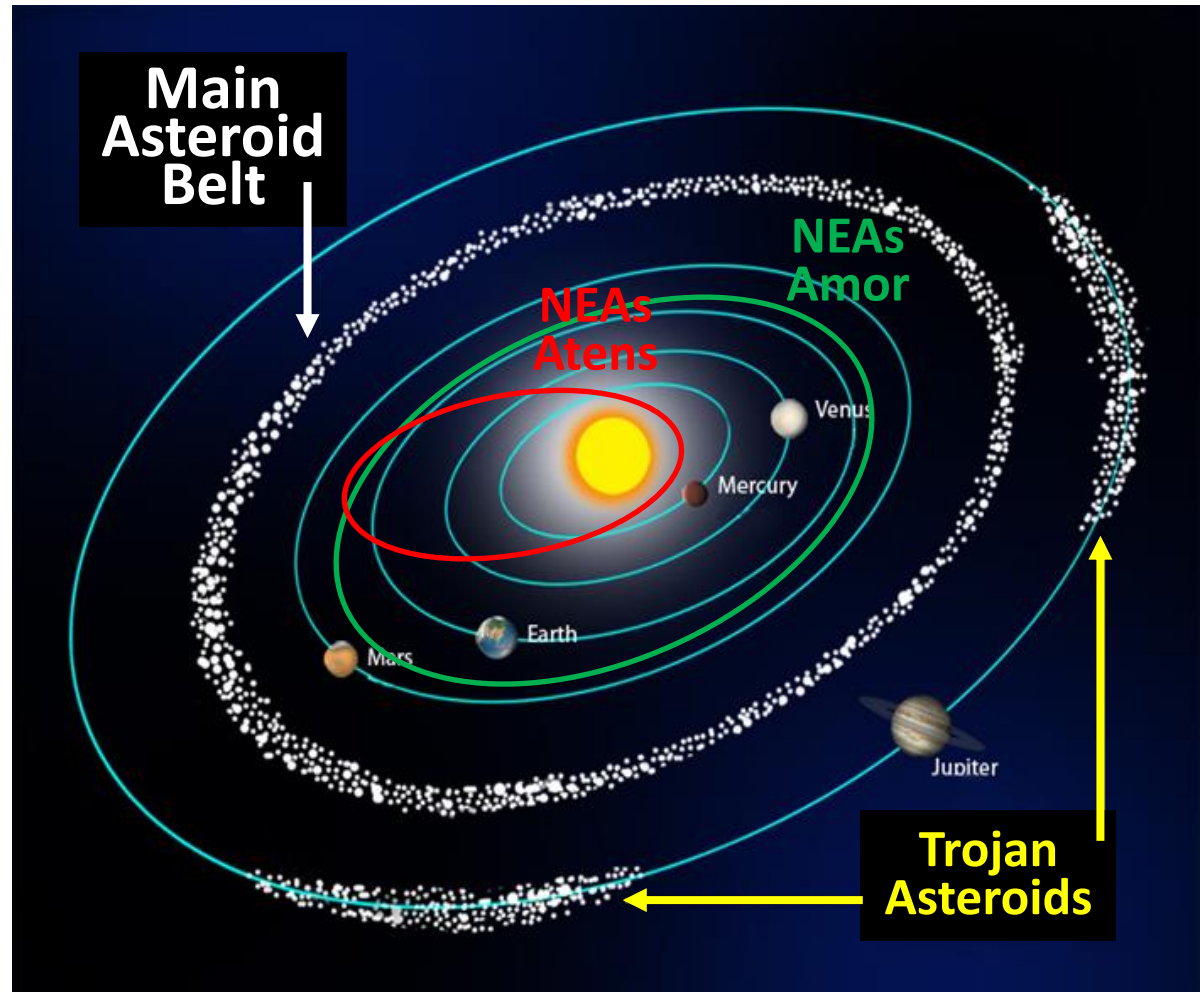
**Meteor:** The light phenomena which results when a meteoroid enters the Earth's atmosphere and vaporizes (a shooting star); **not an object!**

**Meteorite:** A meteoroid that survives its passage through the Earth's atmosphere and lands upon the Earth's surface.

# Asteroids: Location

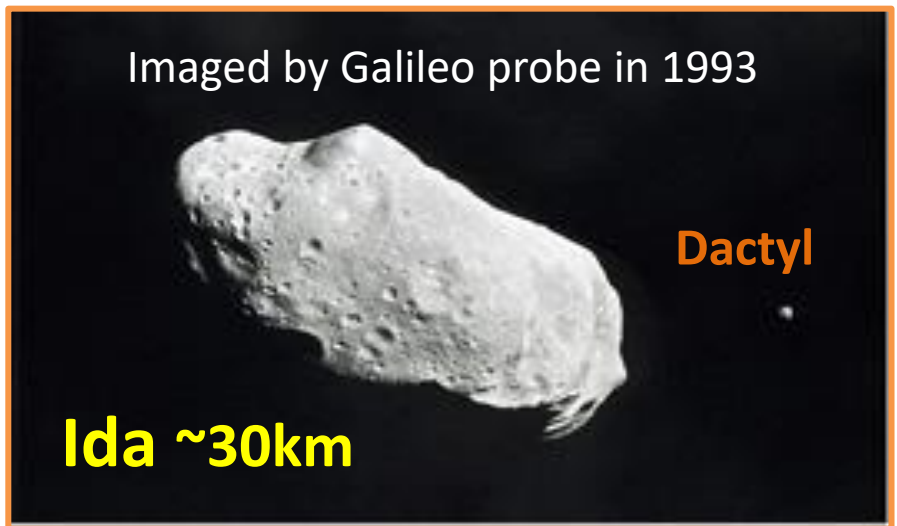
Most asteroids (*millions in total!*) are found between the orbits of Mars and Jupiter in the **main asteroid belt**.

- Additionally, some are located in the same orbit as Jupiter, but are separated from it by  $\sim 60^\circ$  - **Trojans**.
- Some asteroids are in **highly elliptical orbits** that pass close to Earth: Near-Earth asteroids (NEAs), some of them are **Earth-approaching** or **Earth-crossing**.



# Asteroid Facts

- **Total mass** of all asteroids: **~5% of the Moon mass**.
- Asteroids are **too small to be seen with the naked eye** – need large powerful telescopes (*one exception: Vesta*).
- The **average surface temperature** of a typical asteroid is **-100°F**.
- About 15 larger than 250 km (155 mi) are currently known.
- >1,000,000 larger than 1 km and the number increases rapidly with decreasing size.
- Asteroids are **irregularly shaped**; larger ones appear as “rubble piles”.




- Some even have **their own moon!**

# Biggest Asteroids of the Solar System

*Three larger than 500 km!*

## Four biggest asteroids in the Solar System

 /SpaceReloaded



**Ceres**  
Mass:  $9.47 \times 10^{20}$  kg  
Ceres makes up a third of the total mass of all asteroids in the Solar System. In 2006, it was classified as a dwarf planet.



**Vesta**  
Mass:  $2.59 \times 10^{20}$  kg  
NASA's Dawn space probe orbited Vesta for over a year, before heading towards Ceres in September. A significant find was evidence of water in the asteroid's composition.



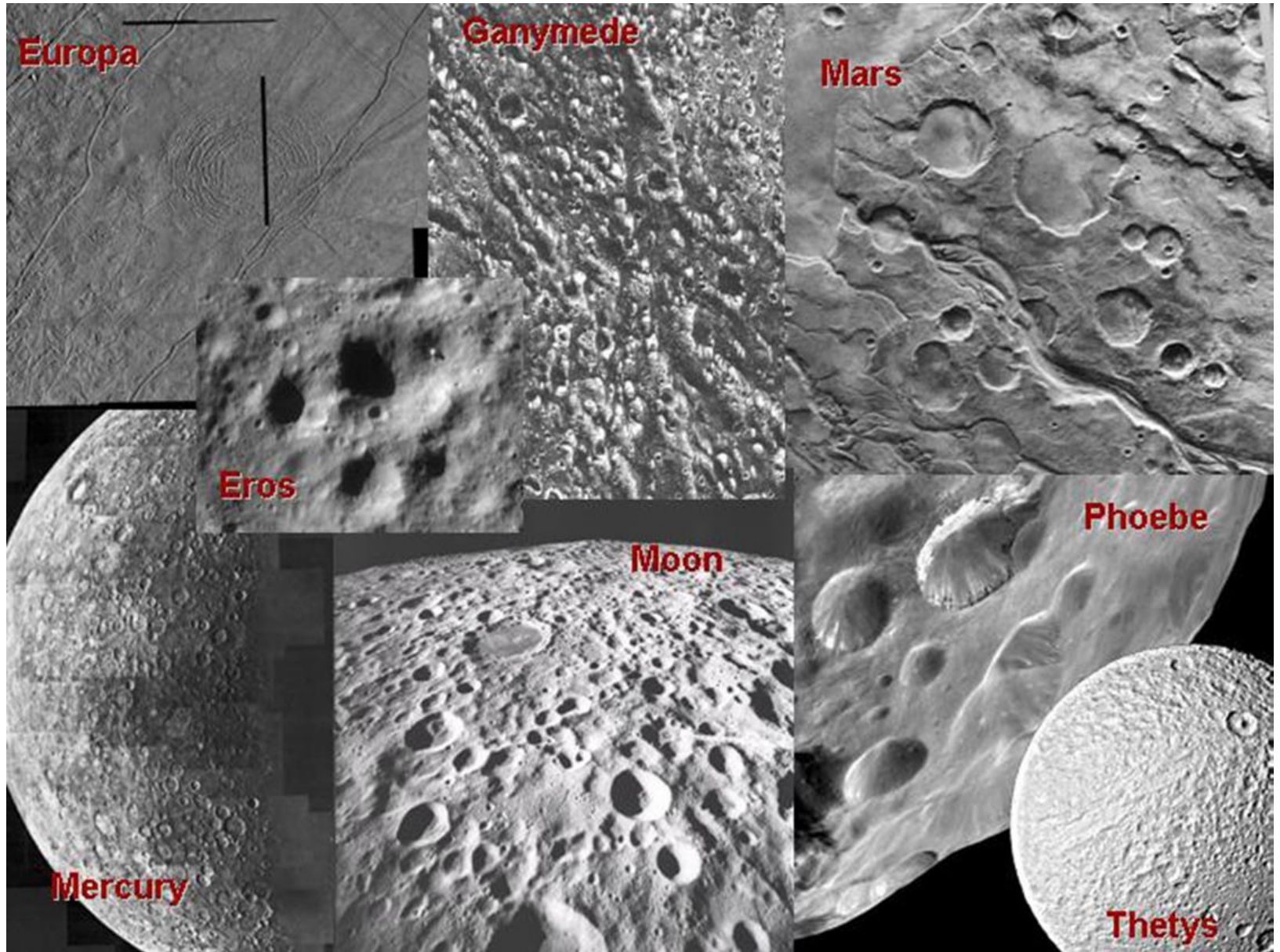
**Pallas**  
Mass:  $2.11 \times 10^{20}$  kg  
The second-biggest in terms of average diameter, Pallas is the largest object in the Solar System that isn't spherical.



**Hygeia**  
Mass:  $8.67 \times 10^{19}$  kg  
Hygeia is the largest known C-type asteroid. Like other C-types, it has a dark surface, making it fairly difficult to see, despite its large size.

Largest (**Ceres**) is 940 km (590 miles) in diameter.

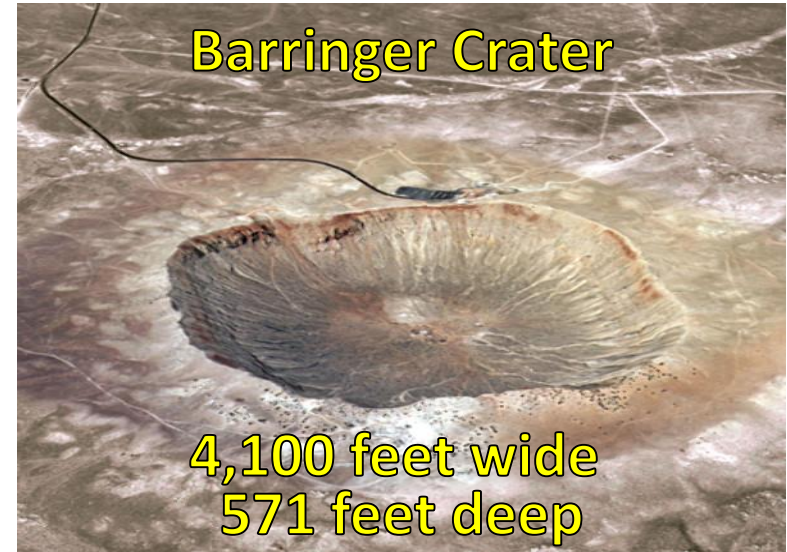
# Little or no atmosphere to protect from the impacts...



# Asteroid Impacts

- Objects with a diameter of **~50 m** (~160 feet) strike Earth approximately **once every 1000 years**:

- **~50,000 years ago: Barringer Crater, Arizona**
- **1908: an asteroid estimated at 50 m across explodes above Tunguska, Siberia, blowing down trees across 2,000 square kilometers and killing a thousand reindeer, but apparently no people. It exploded in the atmosphere so there's no crater.**

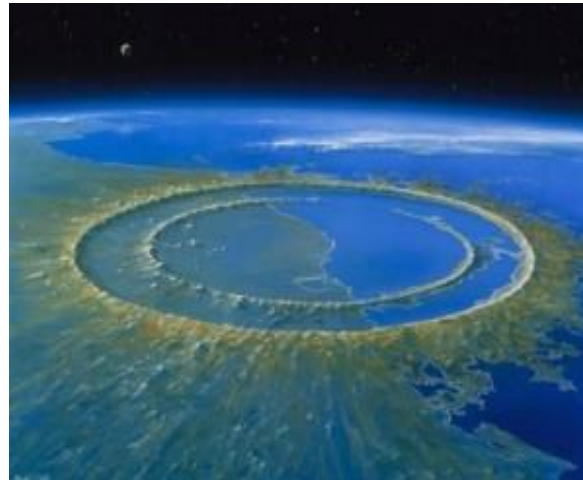


- Asteroids with a **1 km** (0.62 mi) diameter strike Earth **every 500,000 years** on average.
- Large collisions – with **5 km** (3 mi) objects – happen about **once every 20 million years**.
- The last known impact of an object of **10 km** (6 mi) or more in diameter was **65 million years ago**...

# Chicxulub Crater

(tip of the Yucatán Peninsula, Mexico)

One of the largest confirmed impact structures on Earth:  
more than 180 km (110 mi) in diameter and 20 km (12 mi) deep.



- The impacting asteroid was **at least 10 km (6 mi)** across.
- Widely considered by paleontologists the area of impact for the K-T extinction bolide **65 million years ago (mass extinction of some three-quarters of plant and animal species on Earth - including **all non-avian dinosaurs**)**.