Announcements

- WebWork due on Friday
- Starting into Ch 13 content today
- Test 2 is 2 weeks from Friday
- Polling: `rembold-class.ddns.net`

APOD

Review Question

What is unique about the moon Titan?

A. It has numerous volcanos due to tidal heating
B. It likely has an liquid water ocean under the crust
C. It rotates backwards around its host planet
D. It has a dense atmosphere of nitrogen and methane

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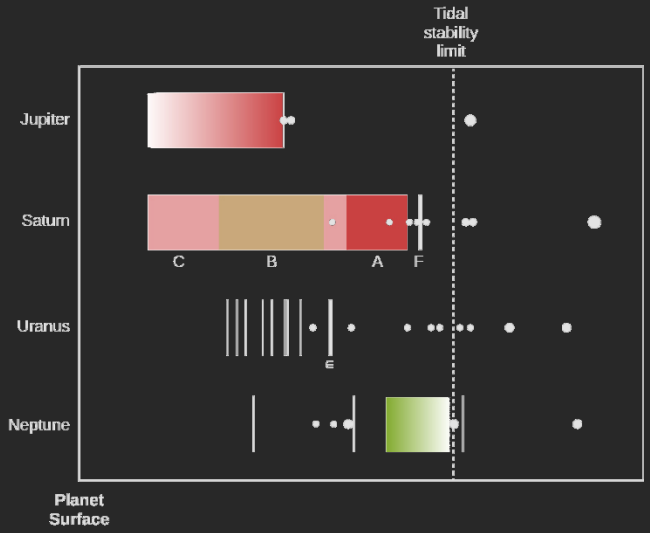
Ring Stability

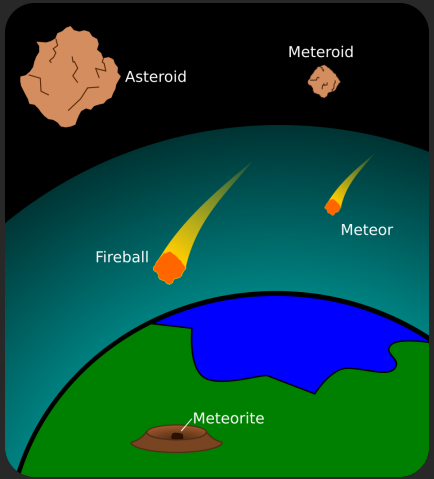


Remembering the little things. . .

At this point we've hit all the major solar system objects. What we have left is the small things:

- Asteroids
- Comets
- Dwarf planets

Asteroids



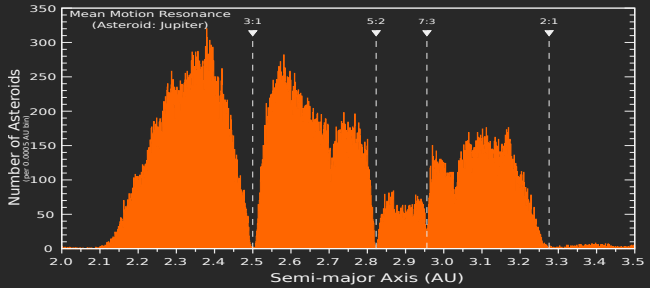
What are asteroids?

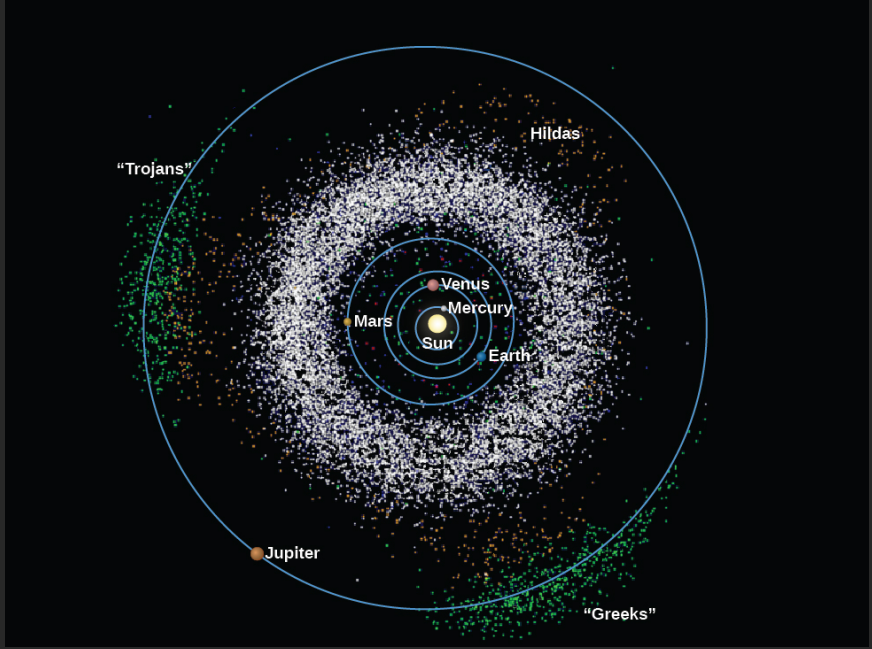
- Small (relatively) chunks of *rock*
- Maybe a million that are $\approx 1\,\text{km}$ across
- Many many more millions are smaller
- Irregularly shaped
- Tiny = hard to see!
- "Primitive"

...To hold up yur britches!

Why do we have an asteroid belt?

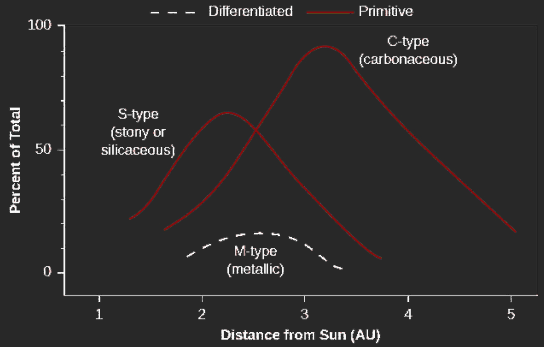
- Rocks further in accreted to form the planets
- Not many *rocks* further out (frost line)
- Jupiter is a bully
  - Asteroids with same period get shoved
  - Keeps the asteroids from slowly accreting together



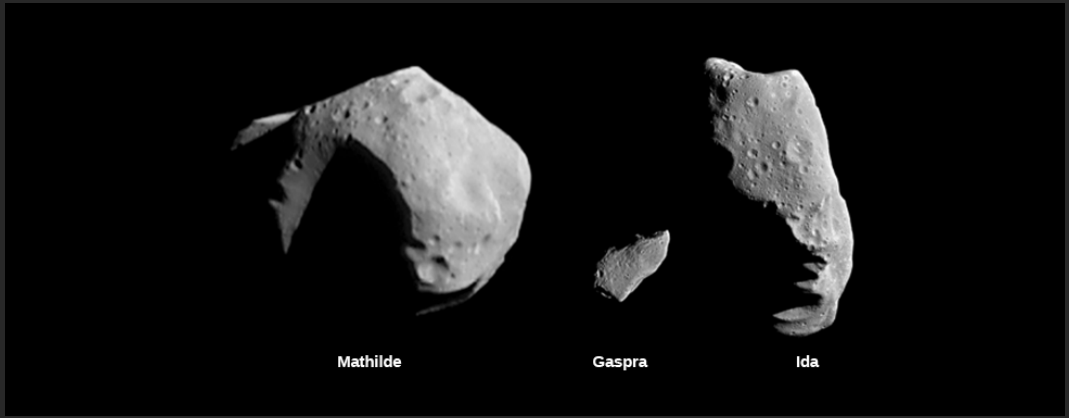

Hildas
“Trojans”
Venus
Mercury
Mars
Sun
Earth
Jupiter
“Greeks”

Composition

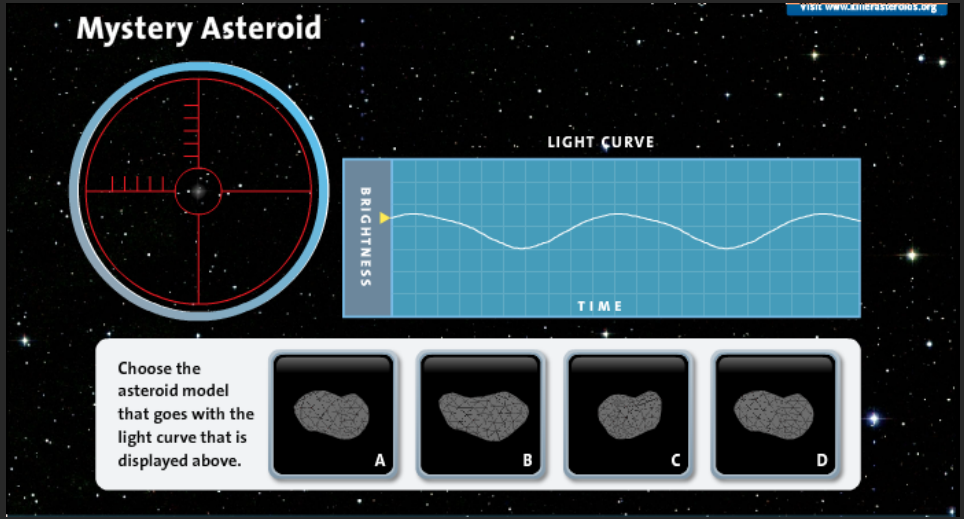
- Compositions are highly varied
- C-type
  - Full of Carbon, dark, and generally further out in the belt
- S-type
  - Stony, brighter
- M-type
  - Metallic, easily seen in radar



Asteroid Shapes



Identifying Shapes

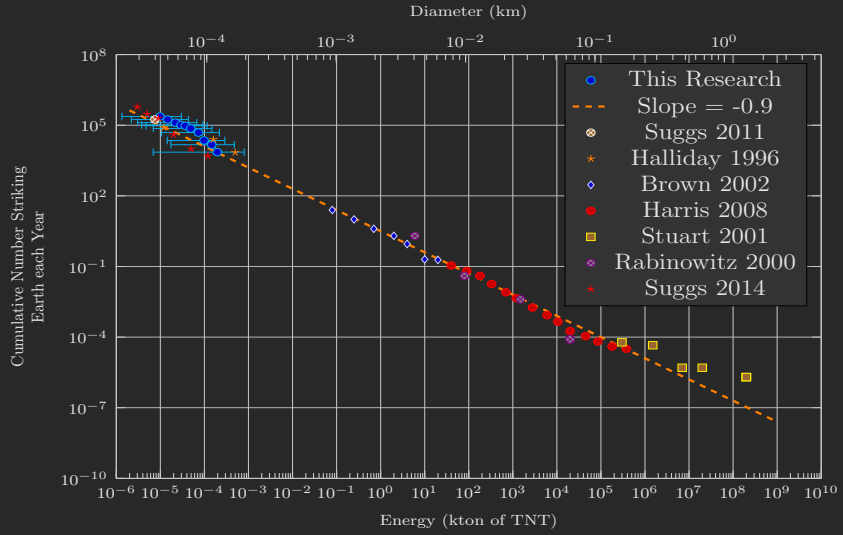


How long before we all die horribly?

Ensuring Life

- Goal is to find 90% of asteroids 1 km or larger with near-Earth orbits
- How do we know when that goal is reached?
  - Crater comparisons
  - Rediscovery analysis
  - Theoretical models
- Estimates that fewer than 10% of asteroids smaller than 1 km have been found
- Probably about a 5 second warning for smaller untracked asteroids
  - Aka: "THERE IS AN ASTEROID IN YOUR ATMOSPHERE RIGHT NOW"

Research!


Diameter (km)
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{8}
10^{5}
10^{2}
10^{-1}
10^{-4}
10^{-7}
10^{-10}
Cumulative Number Striking Earth each Year
10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5} 10^{6} 10^{7} 10^{8} 10^{9} 10^{10}
Energy (kton of TNT)
This Research
Slope = -0.9
Suggs 2011
Halliday 1996
Brown 2002
Harris 2008
Stuart 2001
Rabinowitz 2000
Suggs 2014