



Topic/Objective CHAPTER: 28

NAME:

Asteroids

Pd: 1 2 4 5 other

Is that a video game ..

DATE

Essential Question

What is an asteroid?

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

Between MARS

Between the Mars and Jupiter is this largest gap of space that bugged astronomers; they wanted there to be a planet!

And Jupiter

On January 1, 1801 they got their wish.

Giuseppi Piazzi

Italian astronomer Giuseppi Piazzi found a point of light moving at just the right speed to be the desired planet, but it was just a dot, and too faint to physically be a terribly big object.

Ceres

He suspected it might be a comet, but follow-up observations showed it wasn't fuzzy. The object was given the name

Ceres...

More found

A little over a year later, in 1802, another one was found. Then, in 1804, astronomers spotted a third one, and a fourth in 1807. It was becoming clear that a new class of solar system object had been discovered.

450 total

By the end of the 19th century more than 450 had been found in total and now we know of hundreds of thousands. There are probably billions of them larger than 100 meters across in the solar system, and over a million larger than 1 km in size.

Asteroids

Today, we know that between the 4th planet from the Sun and the 5th planet from the Sun is the largest grouping of rocks, debris left over from the making of the solar system. These groups of rocks are known as Asteroids (Star like).

What are these asteroids?

Not really a definition of what's an asteroid and what isn't.

NOTES CONTINUE ON OTHER SIDE



Topic/Objective CHAPTER:

NAME:

DATE

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

What are asteroid

What are these asteroids?

But, it's a class of smaller bodies that are rocky or metallic that orbit the Sun out to Jupiter. Objects past Jupiter have special designations as TNO's

Despite their huge numbers, they don't add up too much. If you took all the asteroids in the main belt and lumped them together, they'd be far smaller than our own Moon!

Groups of Asteroids

Groups of Asteroids

1. Most are carbonaceous, (75%) (about 3/4 of them)
 - a. means they have lots of carbon in them.
2. About 1/6th are siliceous (17%)
 - a. heavy on the silicon-based materials (rock stuff).
3. Rest are lumped into one catch-all category (8%)
 - a. Dominated by metallic objects, literally loaded with iron, nickel, and other metals.

Dodging asteroid

When you watch movies, they always show spaceships dodging and swooping through asteroid belts, trying to evade them. But our asteroid belt is mostly empty space!

On average, decent-sized asteroids are millions of kilometers apart; if you stood on an asteroid, odds are good you wouldn't even be able to see another one with your naked eye.

the Main Belt

So many of them orbit the Sun between Mars and Jupiter that this region is now called the Main Belt.

SUMMARY:



Topic/Objective CHAPTER: 28

NAME:

Asteroids

Pd: 1 2 4 5 other

Is that a video game

DATE

Essential Question

Where is your Main Belt at?

Cue: Review
Thoughts: Main Idea

NOTE Taking AREA:

Main belt

The Main Belt

structure

- has structure to it
 - there are very few asteroids about 425 million kilometers from the Sun.
 - An asteroid at that distance would have an orbital period of about 4 years; simple fraction of Jupiter's 12-year period.
 - Any asteroid here would feel a repeated tug from Jupiter's mighty gravity, pulling it out of that orbit.
 - The resulting gap is called **the Kirkwood Gap**, and there are several such asteroid deserts, all with simple multiples of Jupiter's period.
- Another way to group asteroids is by orbit
 - some have similar orbits
 - may have formed from a bigger, parent asteroid that got disrupted by an impact.
 - These groups are called **families**
 - example, the Eunomia family
 - over 400 members
 - are **silicaceous**, (rocky asteroids)
 - probably all formed from a parent body that was about 300 km across.

Kirkwood Gap

by orbit

families

quirk of gravity.

There's **another category of asteroid** that exists due to a **quirk of gravity**.

When a planet orbits a star, there are points along the planet's orbit and near it in space where the gravitational forces are in balance. If you place an object there, it tends to stay there. These are called **Lagrange points**

Lagrange points



Topic/Objective CHAPTER:

NAME:

DATE

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

Lagrange points

Lagrange points.

- 1) One of them is along the same orbit as the planet,
 - a) but 60° ahead; another is 60° behind.
 - b) The first such asteroid found was orbiting 60° ahead Jupiter, and was *named Achilles*, after the Greek hero in the Trojan war.
 - i) Asteroids ahead of Jupiter were named after Greek figures in the Trojan war
 - ii) Those behind Jupiter were named for Trojans
 - iii) TODAY we just call them all **Trojan asteroids**.

Trojan asteroids

2) Trojan asteroids have been spotted for

- a) Jupiter, Mars, Uranus, Neptune, and even Earth
 - i) Earth's was found in 2010 using observations by an orbiting observatory called **WISE**,
 - (1) Scans the skies in infrared light, where asteroids glow due to their own heat.
 - (2) 2010 TK7
 - (a) is about 300 meters across and 800 million kilometers away, orbiting the Sun ahead of the Earth.
 - (b) There have orbits like Earth's but are slightly elliptical and tilted with respect to ours. Because of this, they can stay relatively near the Earth in space, but don't really orbit us; instead they sometimes get closer and sometimes recede.
 - (c) Some people say these asteroids are moons of Earth, but it's better to say they're **co-orbital with us**. Only a few are known, the most famous being **Cruithne**, which can get as close as 12 or so million kilometers from us.

WISE

co-orbital with us

Cruithne

SUMMARY:



Topic/Objective CHAPTER: 28

NAME:

Asteroids

Pd: 1 2 4 5 other

Is that a video game

DATE

Essential Question

Why is there even a main asteroid belt at all?

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

Why is there an asteroid belt?

- The solar system formed from a disk of material, and over time, that material started to clump into bigger and bigger pieces.
 - As planets formed, they swept up and pulled in lots more stuff, and grew large.
 - Jupiter consumed a lot of the material around it, but not all, and left a lot of debris inside its orbit.
- Some of this clumped together to form middling-sized objects, probably smaller than the planets we have now, but big enough to undergo **differentiation**:
 - Heavy stuff like metals sank to the middle,
 - lighter stuff formed a mantle and crust.
 - Collisions broke almost all of them apart, though, and that's why we see asteroids with different compositions:
 - Some are from the denser core, others from the lighter crust.
- There was probably a lot more material between Mars and Jupiter billions of years ago, but it either got eaten by Jupiter, or the planet's immense gravity altered the asteroids' orbits, flinging them away.
- This may be why Mars is so small, too; Jupiter robbed it of all its food as it formed.

differentiation

NOTES CONTINUE ON OTHER SIDE



Topic/Objective CHAPTER:

NAME:

DATE

Cue: Review:
Thoughts: Main Idea

Amor asteroids

Apollo asteroids

Aten asteroids

asteroids that
can hit us

While most asteroids live in the main belt, not all of them do. Some have orbits that cross that of Mars, taking them closer to the Sun. Called **Mars-crossing asteroids**. (**Amor asteroids**)

Some have orbits that take them even closer to the Sun, crossing Earth's orbit, called **Apollo asteroids**. They're named after the asteroid Apollo, the first of its kind to be found.

Some have orbits that are almost entirely inside Earth's orbit, called **Aten asteroids**. **Aten and Apollo asteroids** can get close to Earth, so they are called **Near-Earth Asteroids**.

Now, while they get close to us, that doesn't mean they'll hit us. Because some have orbits may be tilted. Their orbits and the orbit of the Earth don't ever physically cross. But... some do have paths that literally intersect Earth's. That doesn't mean they'll hit us every pass, either. You can walk across a street without getting hit by a car. The problem comes when you try to occupy the same volume of space as a car at the same time.

Astronomers are concerned about **asteroids that can hit us**. That's why we have surveys, observatories scanning the skies, looking for them.

Apophi's 4/13/2036

SUMMARY:



Topic/Objective CHAPTER: 28

NAME:

Asteroids

Pd: 1 2 4 5 other

Is that a video game

DATE

Essential Question

Are you Ceres?

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

Ceres

1. the biggest asteroid, at about 900 km across.
2. It's round
 - a. nearly spherical due to its own gravity crushing it into a ball.
 - b. Spacecraft named Dawn has visited an asteroid for the 1st time.
3. has a rocky core surrounded by a water ice mantle
 - a. The amount of water in it is staggering, probably more than all the fresh water on Earth.
 - b. It may even be liquid under the surface, like the oceans of Enceladus and Europa.
4. Images by Dawn shows its surface is heavily cratered
 - a. Some craters are very bright; they may be exposing ice under the surface, or just fresher, brighter material.
 - b. There are observations of localized water vapor on the surface, which may be from sublimation.
 - i. ice turning directly into a gas due to the Sun's heat
 - c. it might indicate cryovolcanoes.
5. Dawn also visited **Vesta**
 - a. the third largest
 - b. Second most massive asteroid known.
 - c. Vesta is round...ish
 - i. what's called an **oblate spheroid**
 1. flattened a bit like a ball someone's sitting on.
 - d. Southern hemisphere got hammered by impacts long ago, leaving a huge basin there.
6. Several other main-belt asteroids have been visited by spacecraft, mostly flybys
 - a. Lutetia, Gaspra, Steins, Mathilde, Ida is another
 - i. discovered to have a small moon orbiting it.

NOTES CONTINUE ON OTHER SIDE



Topic/Objective CHAPTER:

NAME:

DATE

Cue: Review:
Thoughts: Main Idea

NOTE Taking AREA:

- b. In fact, a lot of asteroids have moons or are actually binary, with two similarly-sized bodies in orbit around each other.
- c. Kleopatra is a weird dog bone-shape rock, has 2 moons

- You might think **asteroids are just giant versions of rocks** you might find in your garden; tough, solid, singular bodies. But it turns out that's not the case.
 - Scientists realized that asteroids have spent billions of years whacking into one another
 - sometimes in high-speed collisions
 - sometimes more slowly
 - Slower hits can disrupt the asteroid, crack it, but not necessarily be strong enough to disrupt it so that it breaks apart.
 - Over time, enough hits like that can leave behind what's called a **rubble pile**:
 - *Individual rocks held together by their own gravity*
 - like a bag of gravel
 - Car window that's been cracked and still holds its overall shape
- This became clearer when the Japanese Hayabusa spacecraft visited the asteroid Itokawa
 - saw what can only be described as a jumbled mess.
 - The asteroid had no craters on it
 - was littered with rubble and debris.
 - very low density for a loosely bound rock pile.
- It's weird to think of some asteroids as being not much more than free-floating bags of gravel, but the Universe is under no obligation to adhere to our expectations.

Originally, asteroids were named after female goddesses. Ceres, Vesta, Juno, and so on. But as hundreds more were found, and then thousands, we ran out of names. Eventually astronomers who discovered asteroids were allowed to name them

SUMMARY: