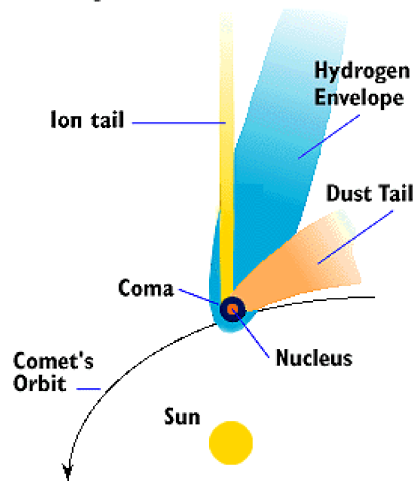


Parts of Comet

Components of Comets



Nucleus:

- *The nucleus is the **frozen center of a comet's head**.
- *It is composed of ice, gas, and dust.
- *The nucleus contains **most of the comet's mass but is very small** (about 1 to 10 km across - or more).

Coma:

- *The coma is the roughly **spherical blob of gas that surrounds the nucleus of a comet**
- *It is about a million km across.
- *The coma is comprised of water vapor, carbon dioxide gas, ammonia, dust, and neutral gases that have sublimed from the solid nucleus (Subliming is when a material goes directly from being a solid to being a gas & skips the liquid phase altogether).
- *The coma and the nucleus form the head of a comet.

Ion Tail:

- *A tail of charged gases (ions) always faces away from the sun because the solar wind (ions streaming from the sun at high velocities) pushes it away (it is also called the plasma tail).
- *When the comet is **approaching** the Sun, the ion tail **trails** the comet: when the comet is **leaving** of the Sun, the ion tail **leads**. The tail **fades** as the comet **moves far from** the Sun.
- *The ion tail can be well over 100 million km long.

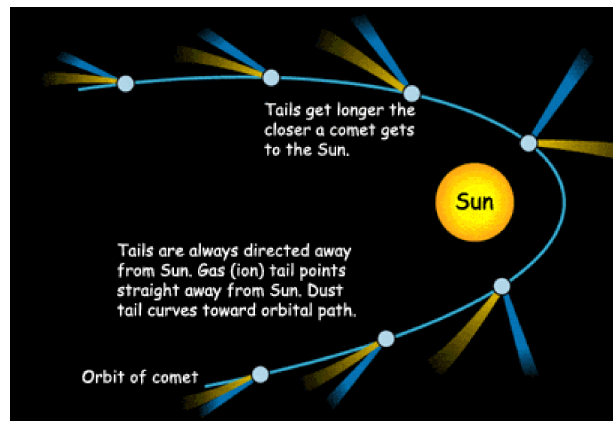
Dust Tail:

- *The dust tail is a long, wide tail composed of microscopic dust particles that are buffeted by photons emitted from the Sun.
- * This tail **curves** slightly due to the comet's motion.
- * The tail fades as the comet moves far from the Sun.

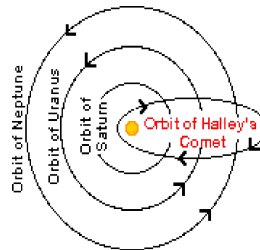
Hydrogen Envelope:

- *Hydrogen gas surrounds the coma of the comet and trails along for millions of miles.
- *It is usually located between the ion tail and the dust tail.
- *The hydrogen envelope is about 10 million km across at the nucleus of the comet and about 100 million km long.
- *It is **bigger** when the comet is **near** the Sun.

- ___ 4. According to the narrative above, which part of a comet surrounds the coma and gets bigger as the comet approaches the Sun?
- a. Hydrogen Envelope b. Dust Tail
- ___ 5. According to the narrative above, which part of a comet contains most of the comet's matter in the form of ice, gas and dust?
- a. Nucleus b. Dust Tail
- ___ 6. According to the narrative above, which part of a comet originates when water vapor, carbon dioxide gas, ammonia, dust, and neutral gases **sublime** from the solid nucleus?
- a. Dust Tail b. Coma
- ___ 7. According to the narrative above, which part of a comet is composed of charged gases that always point **away** from the Sun?
- a. Ion Tail b. Dust Tail
- ___ 8. According to the narrative above, which part of a comet is composed of microscopic particles that **curve slightly** due to the movement of the comet?
- a. Nucleus b. Dust Tail

A Comet's Orbit

- *Comets orbit the Sun in highly **elliptical** orbits.
- *Their **velocity increases** greatly when they are **near** the Sun and **slows down** when it is far out in the orbit.
- *Since the comet is light **only** when it is **near** the Sun (and it is vaporizing), comets are **dark** (virtually invisible) throughout most of their orbit.
- *The solar wind pushes the tail **away** from the Sun.
- *Some comets crash into the Sun or get so close that they burn up; these comets are called **sungrazers**.



A Few Comets	Discovered	Last Visit	Next Visit	Period(years)
Halley	240 B.C.	1986	2061	76.00
Encke	1786	1997	2000	3.28
Biela	1772	1852	broken up	6.62
Faye	1843	1991	1999	7.34

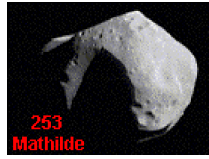
- ___ 9. According to the narrative above, what is the shape of a comet's orbit?
- perfectly circular
 - oval or elliptical
- ___ 10. According to the narrative above, what happens to the speed of the comet as it **approaches** the Sun?
- The comet's speed increases.
 - The comet's speed decreases.
- ___ 11. According to the narrative above, when is a comet most visible?
- The comet is most visible at its furthest point from the Sun.
 - The comet is most visible at its closest point to the Sun.
- ___ 12. According to the narrative above, where do the ions originate that push the comet's tale **away** from the Sun?
- The ions originate from the Sun.
 - The ions originate from the Asteroid Belt.
- ___ 13. According to the narrative above, the **orbit of comets** extend even further than the orbital path of ____.
- Neptune
 - Earth
- ___ 14. According to the narrative above, which comet will **never** be observed again?
- Biela
 - Faye
- ___ 15. According to the narrative above, which comet takes the **longest time to complete its orbit**?
- Halley
 - Encke
- ___ 16. According to the narrative above, which comet takes the **least amount of time** to complete its orbit?
- Halley
 - Encke
- ___ 17. According to the narrative above, which comet has the **greatest average distance** from the Sun?
- Halley
 - Encke

- _____ 18. According to the narrative above, how does a comet change as it orbits the Sun?
- | | |
|---|--|
| <p>a. 1. A comet has an icy nucleus when it is far from the Sun.</p> <p>2. Its nucleus becomes gaseous and expands into space, forming a diffuse coma ("halo") of dust and evaporated gas around the nucleus as it approaches the Sun.</p> <p>3. The tail of the comet is always pointed away from the Sun.</p> <p>4. The comet travels in an elliptical orbit around the Sun.</p> | <p>b. 1. A comet has an icy nucleus when it is far from the Sun.</p> <p>2. Its nucleus becomes gaseous and expands into space, forming a diffuse coma ("halo") of dust and evaporated gas around the nucleus as it approaches the Sun.</p> <p>3. The tail of the comet is always pointed away from the Sun.</p> <p>4. The comet travels in a rectangular orbit around the Sun.</p> |
|---|--|

Asteroid Composition

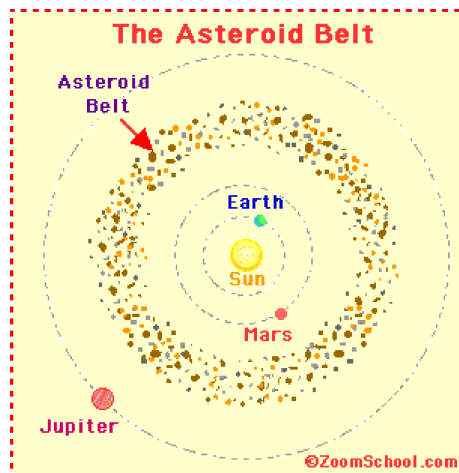
Type	Composition (What it is made of)	Percentage of Asteroids are this type.
Carbon (C-type)	Carbon	Over 75 percent
Silicate (S-type)	Metallic iron mixed with iron-silicates and magnesium-silicates	17 percent
Metallic (M-type)	Iron/ nickel	less than 7 percent
Dark (D-type)	Water ice/frozen carbon monoxide mixed with rock	less than 1 percent

- _____ 19. According to the diagram above, what is the **least common composition** of an asteroid?
- | | |
|--|---|
| <p>a. Water ice/frozen carbon monoxide mixed with rock</p> | <p>b. Metallic iron mixed with iron-silicates and magnesium-silicates</p> |
|--|---|

ASTERIODS & METEORIODS

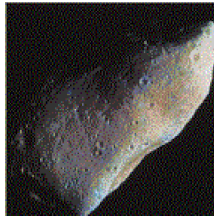
Asteroid 253 Mathilde, a Near-Earth Asteroid photographed by NASA's NEAR (Near Earth Asteroid Rendezvous) mission in June 1997. Mathilde is about 60 km in diameter and orbits in the asteroid belt between Mars and Jupiter.

- * Asteroids are **rocky** or **metallic** objects.
- * Most asteroids orbit the Sun in the asteroid belt **between Mars and Jupiter**.
- * A **few** asteroids approach the Sun more closely.
- * **None** of the asteroids have atmospheres.
 - * Asteroids are also known as **planetoids** or **minor planets**.

THE ASTEROID BELT

- * The asteroid belt is a doughnut-shaped **concentration of asteroids** orbiting the Sun **between the orbits of Mars and Jupiter**, closer to the orbit of **Mars**.
- * Most asteroids orbit from between 186 million to 370 million miles from the Sun.
- * The asteroids in the asteroid belt have a **slightly elliptical** orbit.
- * The time for **one revolution** around the Sun **varies** from about **three to six Earth years**.
- * The **strong gravitational force** of the planet **Jupiter** pulls the asteroids away from the Sun, keeping them from crashing into the inner planets.

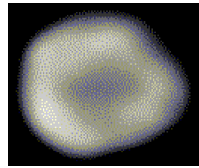
HOW MANY ASTEROIDS ARE THERE?



Gaspra, Asteroid #951.

- * There are about 40,000 known asteroids that are over 0.5 miles (1 km) in diameter in the asteroid belt.
- * About 3,000 asteroids have been cataloged but there are many more smaller asteroids still uncataloged.
- * The first asteroid discovered (and the biggest) is named **Ceres**; it was discovered in 1801.

THE SIZES OF ASTEROIDS



Asteroid 4 Vesta, the **brightest asteroid** and the fourth largest. Vesta is the only asteroid that can be seen without a telescope (it is sixth magnitude).

- * Asteroids range in size from tiny pebbles to about 578 miles in diameter (Ceres).
- * Sixteen of the 3,000 known asteroids are over 150 miles in diameter.
- * Some asteroids even have orbiting moons.

CERES: THE LARGEST ASTEROID

- * Ceres is the largest of the asteroids.
- * It was the first asteroid ever discovered (by the Italian astronomer Giuseppe Piazzi on January 1, 1801).
- * Ceres is the size of the state of Texas! It is so huge in comparison with the other asteroids that its mass is equal to over one-third of the estimated total mass of all the 3,000 cataloged asteroids.
- * Ceres is about 578 miles in diameter. Ceres is now considered to be a **dwarf planet**.

ASTEROIDS BECOMING MOONS



The asteroid 243 Ida and its tiny asteroid moon, Dactyl. This is the first asteroid ever found with an orbiting moon. Ida's dimensions are about 56 x 24 x 21 kilometers (35 x 15 x 13 miles). Dactyl is only about 1.2 x 1.4 x 1.6 km (0.75 x 0.87 x 1 mile) across.

- * Asteroids can be **pulled out of their solar orbit** by the gravitational pull of a planet.
- * They would then orbit that planet instead of orbiting the Sun.
- * Astronomers theorize that the **two moons of Mars, Phobos and Deimos**, are captured asteroids.

ORIGIN OF THE ASTEROID BELT

- * The asteroid belt may be material that never coalesced into a planet, perhaps because its mass was too small; the total mass of all the asteroids is only a small fraction of that of our Moon.
- * The total mass of all the asteroids combined is about 1/30 of the mass of the Moon.
- * A **less satisfactory** explanation of the origin of the asteroid belt is that it may have once been a planet that was fragmented by a collision with a huge comet.

METEORIODS, METEORS & METEORITES

- * **Meteoroids** are small bodies that travel through space.
 - * Meteoroids are smaller than asteroids.
 - * Most are smaller than the size of a pebble.
 - * Meteoroids have many sources.
 - * Most meteoroids come from asteroids that are broken apart by impacts with other asteroids.
 - * Others come from the Moon, from comets, and from the planet Mars.

- * A **meteor** is a meteoroid that has entered the Earth's atmosphere.
 - * It usually makes a fiery trail as it falls.
 - * It is sometimes called a shooting star or a **falling star**.
 - * The **friction** between the fast-moving meteor and the gas in the Earth's atmosphere causes intense heat; the meteor glows with heat and then burns.
 - * Most meteors burn up before hitting the Earth.
 - * Only large meteors can survive the trip through our atmosphere.
 - * A **fireball** is any meteor that is brighter than **Venus**.

- * A **meteor shower** is a phenomenon in which many meteors fall through the atmosphere in a relatively short time and in approximately parallel trajectories.
 - * A very intense meteor shower is called a **meteor storm**.

- * A **meteorite** is a meteor that has fallen to Earth.
 - * These rare objects have survived a fiery fall through the Earth's atmosphere and have lost a lot of mass during that process.
 - * Meteorites are made up of rock and/or metals.

- ____ 20. According to the narrative, what is the **orbit of most asteroids** in our solar system?
- a. Asteroids orbit in an elliptical path around the Sun between Earth & Mars. b. Asteroids orbit in an elliptical path around the Sun between Jupiter & Mars.
- ____ 21. According to the narrative, some of the **larger asteroids** are classified as ____.
- a. Comets b. Dwarf Planets
- ____ 22. According to the narrative, astronomers theorize that the two moons of Mars, Phobos and Deimos, are captured ____.
- a. meteorites b. asteroids
- ____ 23. According to the narrative above, which celestial object is the largest?
- a. Meteor b. Asteroid
- ____ 24. According to the narrative above, where do meteorites come from?
- a. 1. A **meteorite** might have originated in the asteroid belt as a **meteoroid**.
 2. The meteoroid partially burned up upon entering Earth's atmosphere becoming a **meteor** or "shooting star".
 3. It finally landed on the surface of the Earth.
 4. It is composed of rock or metals.
- b. 1. A **meteorite** might have originated in the asteroid belt as a **meteoroid**.
 2. The meteoroid partially burned up upon entering the Moon's atmosphere becoming a **meteor** or "shooting star".
 3. It had to be retrieved from the Moon by a space vehicle and taken to the Earth's surface.
 4. It is composed of rock or metals.
- ____ 25. The **strong gravitational force** of the planet _____ pulls the asteroids away from the Sun, keeping them from crashing into the inner planets.
- a. Jupiter b. Mars

**ES-3 Comets & Asteroids
Answer Section**

MULTIPLE CHOICE

1. B
2. B
3. B
4. A
5. A
6. B
7. A
8. B
9. B
10. A
11. B
12. A
13. A
14. A
15. A
16. B
17. A
18. A
19. A
20. B
21. B
22. B
23. B
24. A
25. A