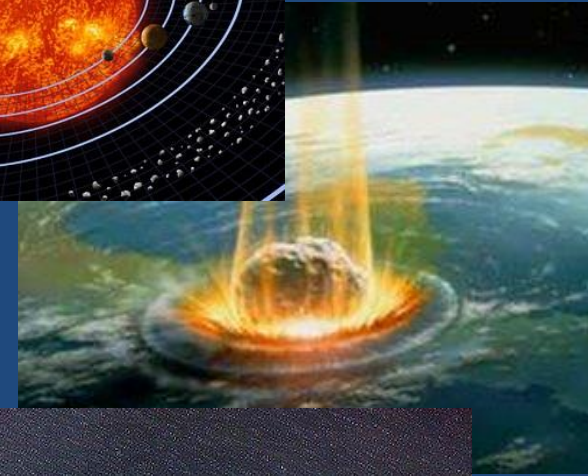
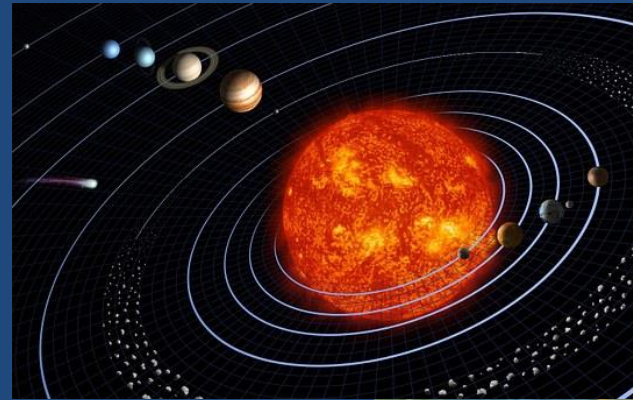


# Asteroids, Comets, and Meteors

- Asteroids
- Meteors,  
Meteoroids, and  
Meteorites
- Comets



# HS-ESS1-6

*SWBAT* apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy.*

# HS-ESS1-6 – Part 2

Meteorites, and other planetary surfaces.

*How are these things involved in the creation (formation) of the Earth?*

*Let's begin by learning what they are!*

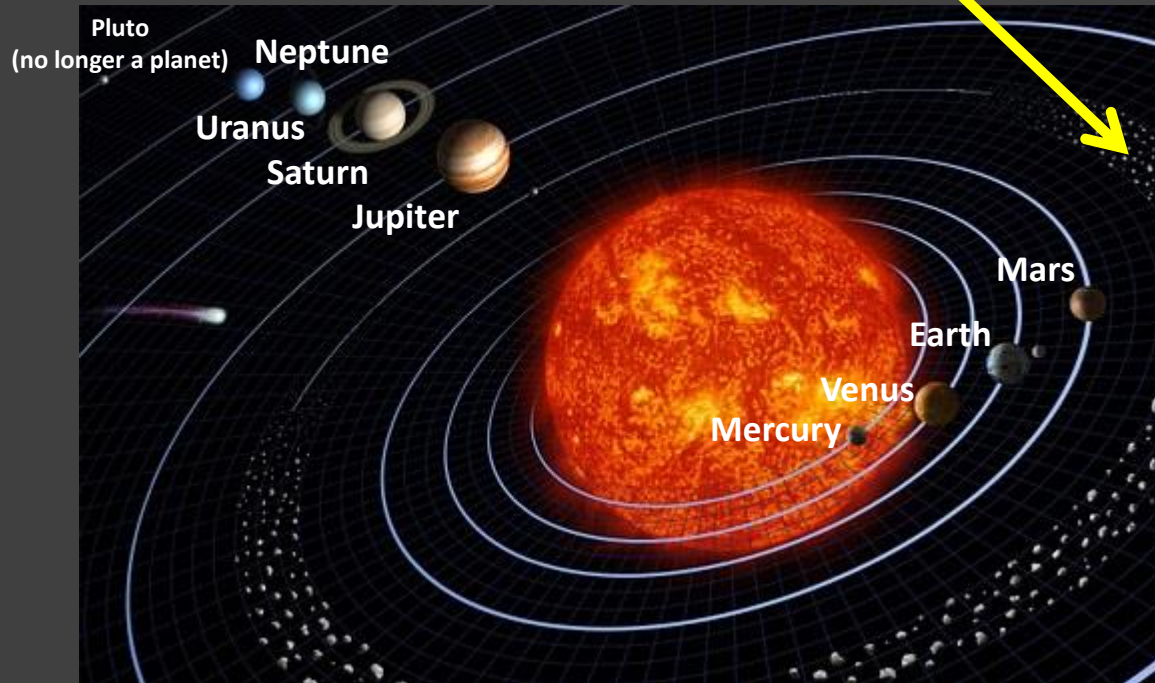
# Asteroids



Visualization of asteroid impact that killed dinosaurs 65 million years ago, based on accurate research and scientific fact.

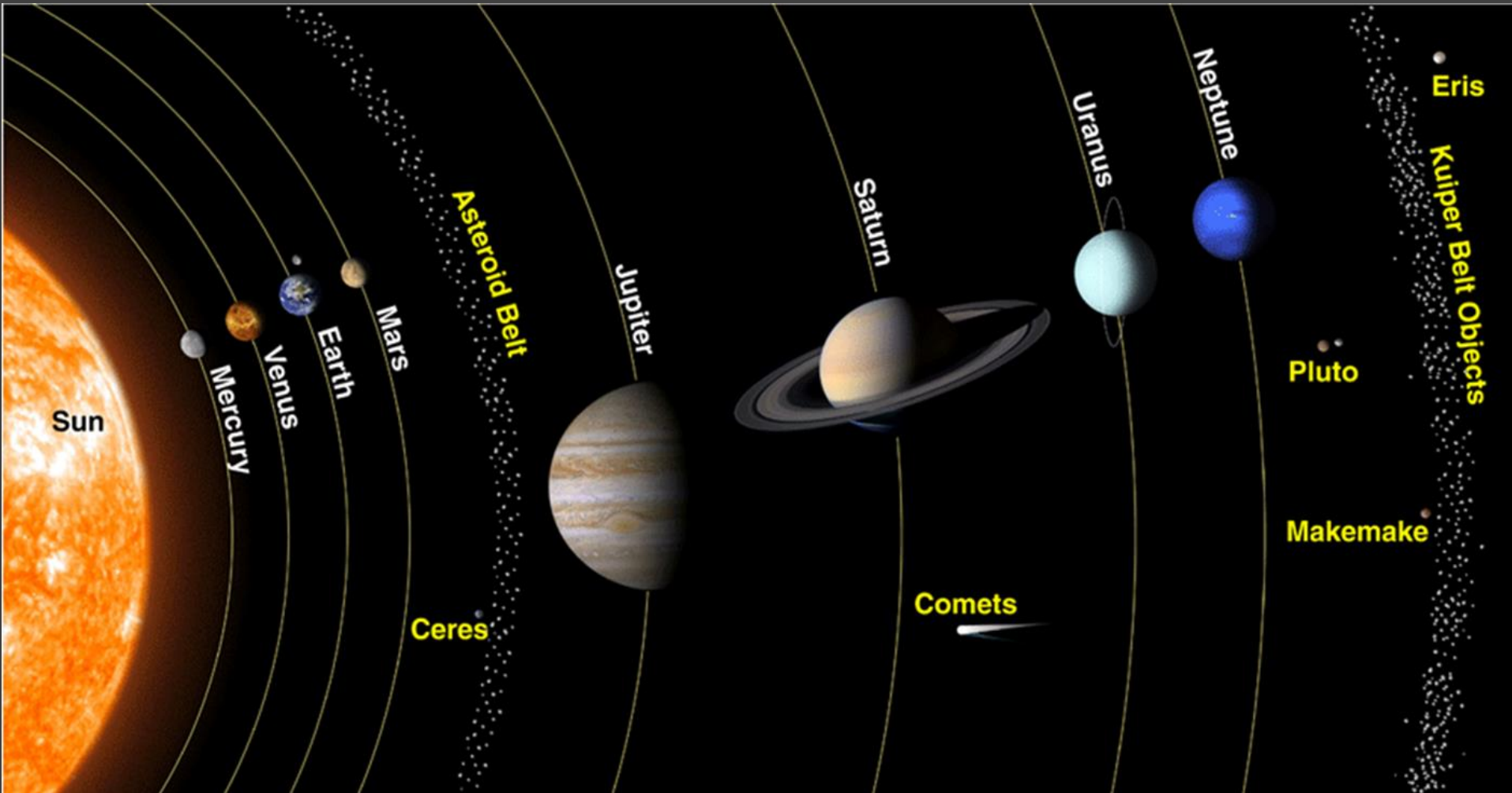
# Asteroids

- Small rocky objects that orbit the Sun
- Billions of small rocky objects in a ring is called the ASTEROID BELT (between Mars and Jupiter)





# The Asteroid Belt



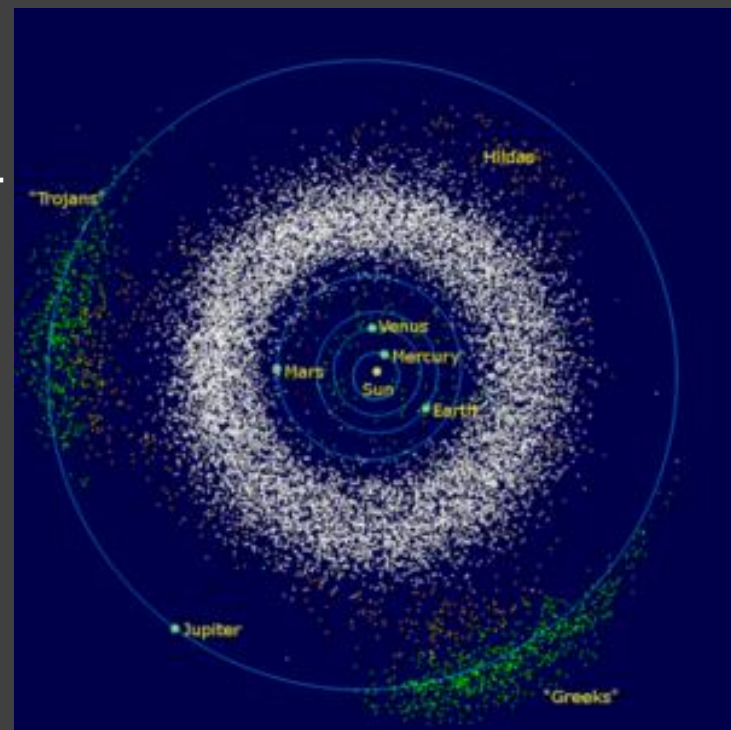
# Asteroids

- Size ranges from 19 ½ feet to 580 miles long
- Dinosaur killer ~ 6 miles across – Traveling at 40,000 miles an hour.
- Landed in the Gulf of Mexico in the Yucatan Peninsula 65 mya – with the force of 100 trillion tons of TNT!
- Created the Chicxulub Crater that is several miles deep and 115 miles across



# The Asteroid Belt

- Most are small, boulder-size to a diameter of a few thousand feet
- Largest have names: Vesta, Pallas, Hygea
  - Each at least 250 miles long
- Dwarf planet within: Ceres
- Total mass of belt < mass of moon
- Asteroids widely spaced apart







4 Vesta



21 Lutetia



253 Mathilde



243 Ida / 1 Dactyl



433 Eros



951 Gaspra



2867 Šteins



5535 Annefrank



25143 Itokawa

# Asteroid Composition

(What asteroids are made of!)

- Three major types of asteroids:
- **C-type** (carbonaceous): >75% of known asteroids
  - Contain large quantities of carbon
- **S-type** (silicaceous): ~17% of known asteroids
  - Made of metallic iron with iron- and magnesium-silicates
- **M-type** (metallic): Most of the rest of the known asteroids
  - Contain large quantities of metallic iron

# Think-Pair-Share

*SWBAT* apply scientific reasoning and evidence from **ancient Earth materials**, meteorites, and other planetary surfaces to construct an **account of Earth's formation and early history** by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy*.

*Consider what asteroids are made of... Why is what they are made of important for Earth? (DOK 1)*

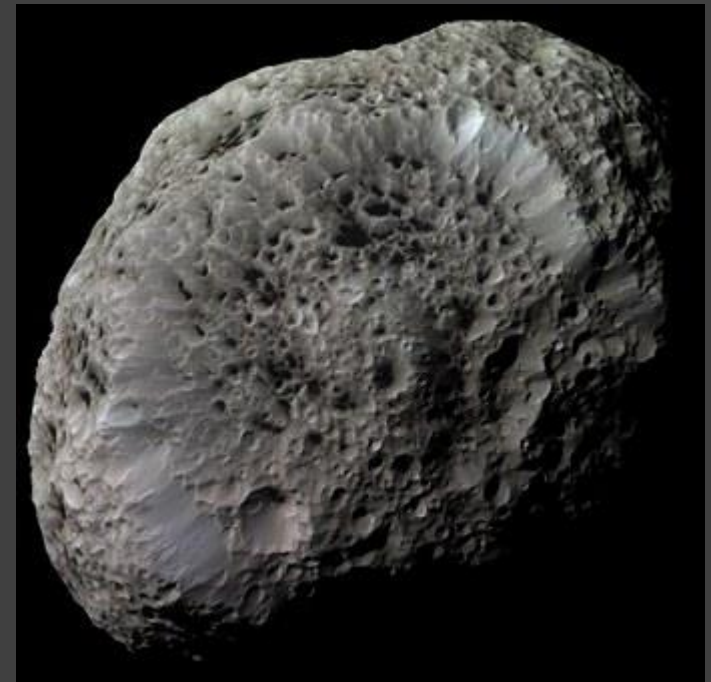
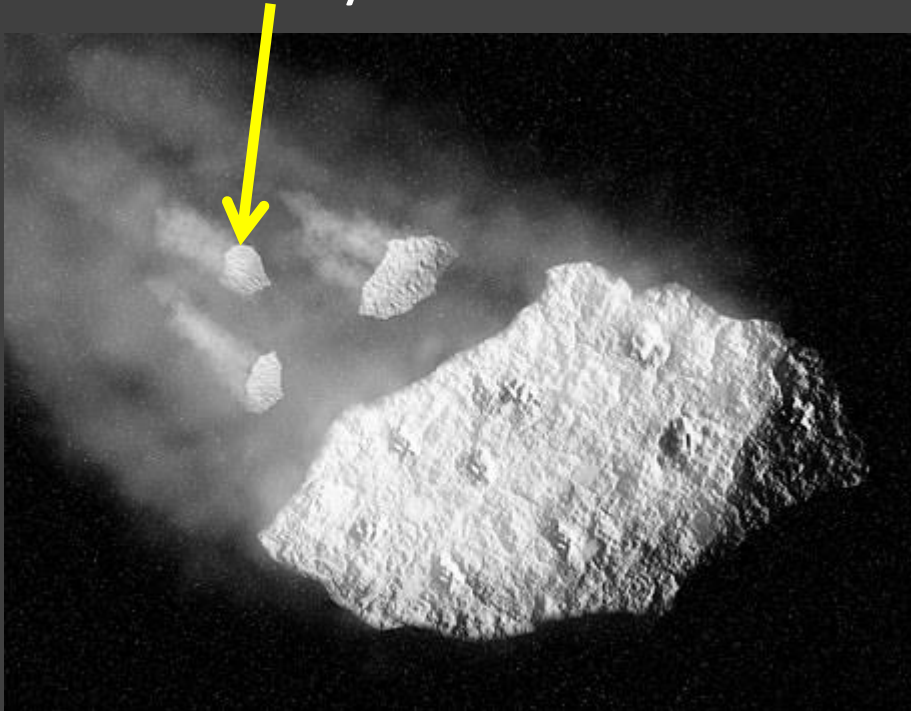
# Think-Pair-Share

*SWBAT* apply scientific reasoning and evidence from **ancient Earth materials**, meteorites, and other planetary surfaces to construct an **account of Earth's formation and early history** by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy*.

*Asteroids contain large quantities of carbon and iron – both of which are necessary for life on Earth!*

# Meteoroid

- A small body moving through the Solar System that has entered the Earth's atmosphere.
- They are MUCH smaller than asteroids and range in size from small grains to 3 feet wide.
- Generally come from an asteroid that has broken up or debris left behind by a comet





# Meteors

- A meteor is a piece of rock or metal that burns very brightly when it enters the Earth's atmosphere from space.
- If a meteoroid comes close enough to Earth and enters the atmosphere, it vaporizes and turns into a meteor – a streak of light in the sky
- Sometimes called a Shooting Star!



# Meteorite

- A meteorite is a meteoroid or asteroid that doesn't completely burn up in the atmosphere and hits the earth.
- Most are small
- 3 types
  - Stony – more than 90% of meteors: mostly silicate minerals (rock)
  - Iron: mostly metallic iron-nickel
  - Stony-iron: both rocky and metallic



# Think-Pair-Share

*SWBAT* apply scientific reasoning and evidence from ancient Earth materials, **meteorites**, and other planetary surfaces to construct an **account of Earth's formation and early history** by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy*.

*Consider the three types of meteorites... What did they have to do with the formation of the Earth? (DOK 1)*

*Answer in complete sentences*

# Think-Pair-Share

*SWBAT* apply scientific reasoning and evidence from ancient Earth materials, **meteorites**, and other planetary surfaces to construct an **account of Earth's formation and early history** by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy*.

*Meteorites are made of the same ingredients that the Earth is made of which suggests they are an important part of Earth's formation.*

# February 2013 Meteor Explosion over Russia





# February 2013 Meteor Explosion over Russia

- The meteor had an initial mass of about 12,000–13,000 metric tonnes (heavier than the Eiffel Tower), and measured between 17 and 20 meters in size (55-65 feet).
- It was moving at approximately 18.6 km/s (over 41,000 mph or 66,960 km/h), almost 60 times the speed of sound.
- It exploded 23.3 km above the ground, releasing the energy equivalent of 500 kilotons of TNT, 20–30 times more energy than was released from the atomic bomb detonated at Hiroshima (but without the radiation).
- The explosion created a shockwave, shattering windows, toppling smaller structures, and injuring thousands.

Recall...

WHY is this called a meteor and not a meteorite?

Recall that a meteorite is a meteoroid or asteroid that doesn't completely burn up in the atmosphere and hits the earth.

Recall that a meteor is a piece of rock or metal that burns very brightly when it enters the Earth's atmosphere from space.

# Comets

- Comets are cosmic snowballs of frozen gases, rock, and dust that travel in a very long orbits around the sun. (They have been referred to as dirty snowballs!)
- When a comet's orbit brings it close to the sun, it heats up and spews dust and gases into a giant glowing head that is larger than most planets!
- Comets have tails over a million miles long!



# Comets

- Comets are leftovers from the beginning of our solar system around 4.6 billion years ago.
- There are likely billions of comets orbiting our sun in the Kaiper Belt and even more in the Oort Cloud.
- We currently know about 3, 535 different comets in our solar system!
- It is Hypothesized that comets are what brought water and organic compounds that ignited life on Earth

# Comets

- Comets are leftovers from the beginning of our solar system around 4.6 billion years ago.
- There are likely billions of comets orbiting our sun in the Kaiper Belt and even more in the Oort Cloud.
- We currently know about 3, 535 different comets in our solar system!
- It is Hypothesized that comets are what brought water and organic compounds that ignited life on Earth



# Think and Write

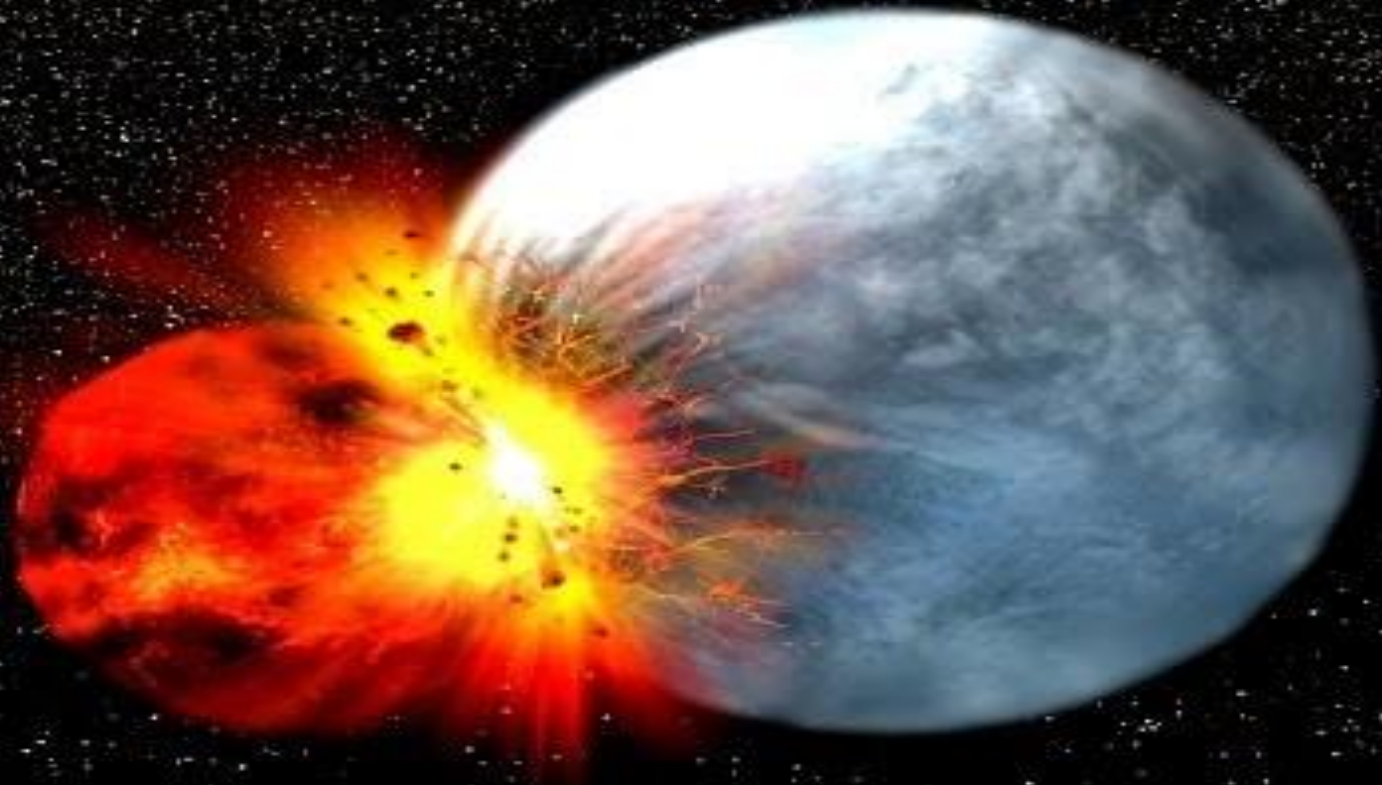
*SWBAT* apply scientific reasoning and evidence from ancient Earth materials, meteorites, **and other planetary surfaces** to construct an **account of Earth's formation and early history** by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy*.

*How have comet's helped to shape the Earth in a way where life was able to take hold? (DOK 2)*

*Comet's helped life take place on Earth by\_\_\_\_\_.*

*Think about what life needs in order to survive...*

# HS-ESS1-6 – Part 2



# Think-Pair-Share-Write

*SWBAT* apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history by completing a Lab Station Activity and Interactive PowerPoint notes *with 85% or more accuracy.*

Identify the major events that explain how the moon was formed according to the video you just watched. (DOK 2)

*According to the video, the moon was formed when ...*

# Think – Share - Write

Using details and examples from the video, your lab station rotation, and from today's powerpoint, synthesize and connect how the Moon was formed and how knowing this would help us understand how the Earth was formed? (DOK 4)

*Recall from the video:*

- In the early solar system, there was a lot of space debris. Asteroids flew around, sometimes striking the planets.
- An asteroid the size of Mars smashed into Earth. The huge amount of energy from the impact melted most of Earth. The asteroid melted too.
- Material from both Earth and the asteroid was thrown out into orbit. Over time, this material smashed together to form our Moon.
- The lunar surface of the Moon is about 4.5 billion years old. This means that the collision happened about 70 million years after Earth formed.