HPS – Video Observations KEY 2021 Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“[Birth of the Solar System](https://live.myvrspot.com/iframe?v=fMzc5NDRhMjlhM2YyZDc1YWIyZmEwZjk4Mjk2NmUwMTI)”

Objective 3: Describe the structural organization of the solar system.

Key Terms: Sun, Planets, Terrestrial, Jovian, Asteroid Belt, Kuiper Belt, Oort Cloud, Comets, Meteoroids

Directions: Pay close attention to the objective and these terms, and write down at least 15 key facts while watching the video.

1755 – Kant focused on Nebular Theory - how solar systems are formed. Collapsed in and formed stars and planets.

Watch how other solar systems are formed in order to help us understand how our own solar system may have formed.

Visible light is blocked by dust and gas. IR (longer wavelength) can be detected by sensors on Spitzer Space Telescope that can see inside clouds to see planets inside. 2003 first data from Spitzer.

Our own nebula began its collapse 4.6 billion years ago. Spinning material collapsed. As nebula contracts, it rotates faster and faster due to conservation of angular momentum. Dense material formed in the middle 🡪 protostar. When it reached a certain temperature (10 million degrees C), it began nuclear fusion.

H atoms fused to form He atoms and released photons in the Sun – if a star is big enough, it will explode 🡪 supernova! E delivered matches the E that the Sun will produce in its entire lifetime. This fuses heavier elements and blasts them into space. Scientists think our nebula came from a supernova.

Scientists studied samples of comets and meteoroids. Scientists need comet catching material as the comet grains move 6x faster than a speeding bullet. \*Stardust Spacecraft\* In 2006 comet particles make it back to Earth.

Meteorites are dated to 4.5 billion years old, so we study them as well. Unstable isotopes of Fe-60 which decays quickly so it must be close. Only made in supernova. Must have been near an infant Sun. Our solar system may have formed right alongside a supernova. Blast waves could have swept the material together and triggered the collapse of the nebula. Then gravity takes over.

Some scientists thought planets grow within the disk around the sun. Experiment in space: friction between grains in zero gravity creates electrostatic charge which pulls grains together in clumps. This would also occur in protoplanetary disk. Accretion!!!! Gravity then causes the clumps to get larger and grow into planetesimals, then full sized planets. Gravity attracts evenly and pulls on material to ultimately form a sphere.

Different kinds of material condense at different kinds of temperatures. All matter near the Sun is gas due to extreme heat. Temperatures cool, but it’s still too hot for gases and ices to condense near the Sun – metals are able to. Also, not much rocky material available.

Terrestrial Planets:

Mercury – highly metallic, HUGE metallic core, no oceans or atmosphere, just rock, hottest side can melt lead

Venus – rocky, high temps, rains sulfuric acid

Earth – rocky, Goldilocks (not too hot or too cold, so conducive to life), ozone protects from harmful UV rays, magnetic field protect the planet from lethal cosmic radiation. Moon? Thea collision! Moon rocks are younger than expected.

Mars – rocky, SS’s largest canyon and largest volcano,

Asteroid Belt – average distance between asteroids is 1 million miles, contains frost line around 450km from Sun beyond which water was cold enough to condense

Jovian Planets (Gas Giants):

10x mass of Earth (critical mass) start sucking up trillions of tons of gas, water/methane/ammonia can condense

Jupiter – largest planet in SS, planet’s gravity is so powerful that it deflects icy comets so they don’t enter the inner planets

Saturn – second largest planet, rings made up of millions of fragments

Uranus – icy, less gas, plain, methane causes green color

Neptune – icy, less gas, blue (last planet)

Pluto – dwarf planet

Kuiper Belt – 70,000 large icy objects, 45 billion km

Oort Cloud – trillion comets, almost a full light year from the Sun (9.5 trillion km)

Exosolar Planet – planet orbiting a distant star! Super big and close to their star!

MYSTERY: Try to apply our models - the formation of Uranus and Neptune, there shouldn’t be enough material to form these planets.

Kuiper Belt shouldn’t be there either.

3.9 my crater impacts on Moon – fell during the late heavy bombardment time period. Materials match the rocks found in asteroid belt. Why though? Hmm….

Hypothesis: planets were in orbits and have since moved

2:1 resonance with Jupiter and Saturn (Jupiter orbited twice for every one time for Saturn) this caused a stretch for their orbits. Uranus and Neptune may have even switched places throwing asteroids every which way!

In 5 billion years, our Sun will run out of fuel and expand, swallowing up the inner planets.