The Solar System

Earth Systems Unit 2
26.2,

- The Cosmos
- https://www.youtube.com/watch?v=onvSeBS6nLM
- (34 min)
- During the video, you need to write down 5 questions / thoughts you have.
- After the video: Write a quick summary of the most interesting topic presented in this video.

http://www.glencoe.com/sites/common_assets/science/virtual_labs/E28/E28.swf

Newton's Law of Gravitation

- Newton's first law states an object will move forever in a straight line at the same speed unless some external force changes its direction or speed.
- Planets orbit the sun because of gravity.
- Law of gravitation: ever mass exerts a force of gravitation on every other mass, and strength of force is proportional to each of the masses and inversely proportional to the distance between them.

Our Solar System

- Consists of 8 planets, sun, moons, many dwarf planets (Pluto), an asteroid belt, comets, meteors and others
- Mercury, Venus, Earth, Mars, Jupiter, Saturn,, Uranus, Neptune, Pluto
- "My Very Energetic Mother Just Sent Us Nine Pizzas"

Vocabulary

- Astronomical Unit (AU)- the distance between Earth and the sun (~1.495 x 10^8 km)
- Rotational Period: length of day (length to rotate OWN axis)
- Orbital Period: length of year in Earth days (time to fully orbit sun)
- Retrograde- when planet rotates opposite Earth or clockwise
- Tilt- how far a planet is tilted sideways on its axis, measured in degrees.

The Inner Planets

- Inner planets: Four nearest the sun: Mercury, Venus, Earth, and Mars.
- Rocky crusts, dense mantle layers, very dense cores.
- Sometimes called terrestrial planets (earthlike)
- Relatively small, have few or no moons

Outer Planets

- Just beyond mars is a belt of asteroids; asteroid belt separates inner & outer planets.
- Jupiter, Saturn, Uranus, Neptune, Pluto (dwarf planet)
- Mostly huge, mostly gaseous, have many moons
- Pluto = exception- dwarf planet (small), rocky, 5 moons

Mercury

- Nearest the sun
- Shortest orbital period: 88 Earth days
- Smallest of terrestrial planets (diameter 38% of Earth)
- *Mariner 10* photgraphed '74, '75
- Heavily cratered (like Earth's moon) rest is smooth plains formed by lava
- Rotational Period: 59 days
- Day temps 400°C , night -200°C (slow rotation)
- Weak gravity- no atmosphere
- Can be seen from Earth (more difficult-smaller and less bright than Venus, orbit close to sun)

Venus

- "Earth's sister planet" (mass, gravity, diameter)- unlike earth= weak/noexistant magnetic field
- Rotates E→W; rotational period= 243 days
- Orbital Period: 225 days (day longer than year)
- Thick yellow cloud blocks surface- *Magellan* spacecraft '90 (radar shows surface similar to E)
- Oldest crust = 800 million years old (Earth 4.3 billion)
- Mostly carbon dioxide atmosphere (yellowish clouds droplets of sulfuric acid)
- Very hot! ~ 475°C (CO_2 atmosphere acts like greenhouse)
- Can be see from Earth (morning, evening "star") when behind E in orbit –evening star western sky; in front of E- Eastern sky before sun up

Mars

- 4th planet from sun- 1st outside E's orbit
- Orbital Period: 687
- Diameter half of E (2/5 gravity of E's)
- Tilt ~ same angle, direction as E = 4 seasons, similar to E's (2x long)
- 27°C summer day - -133°C winter night
- 95% CO_2 atmosphere
- Temp changes create massive wind storms
- Several spacecraft camera have photographed surface- largest volcano in S.S.- Olympus Mons (500kmx26km high) – not due to plate motion (solid crust)

Can it support life?

- Polar ice caps (water ice over frozen CO_2)
- Southern hemisphere *Valles Marineris* (canyon length of US wide)
- 4 billion years ago may have had thick atmosphere, blue sky and abundant water *Valles Marineris* may have once help lakes of liquid water. Next billion years- atmosphere disappeared, present liquid water cannot exist on Mars- boil/freeze.
- Once liquid water now trapped as ice below surface.
- Possible primal life before atmosphere thinned

Jupiter

- 5th planet from sun.
- Orbital period: 11.9 E yearss
- Rotates fastest- rotational period 10 hours
- Largest planet in solar system (more than 2x mass of all planets in S.S combined!)
- Strongest magnetic field- solar winds interact w/ to make auroras (like E)
- Radiates 2x as much heat back to space as receives from sun (heat of formation, compaction due to gravity)
- Great Red Spot
- Galileo probes enter atmospher (first for US on giant planets.)
- Probe found no thick dense clouds (surprise)
- Also revealed higher temps & pressure in outer atmosphere than expected
- Atmospher is convective

Saturn

- 6th planet from sun
- 30 E years orbital period
- Rotational period ~ 10 hours
- Colored zones and belts (rising and sinking gases) - like Jupiter
- Lowest density of any planter (would float)
- Radiates more energy than recieves (sources of internal heat like Jupiter)

Uranus

- 7th planet from sun
- Orbital period 84 years
- Not easily visible to unaided eye from E so not discovered until 1781
- 19x further from sun than E (sunlight 370x fainter)
- -200C
- Rotational period: 17.2 hours (tipped almost completely on side)- think due to collision with E-like mass early in history of S.S
- Voyager 2 flew past '86- discover magnetic field not tipped like axis

Neptune

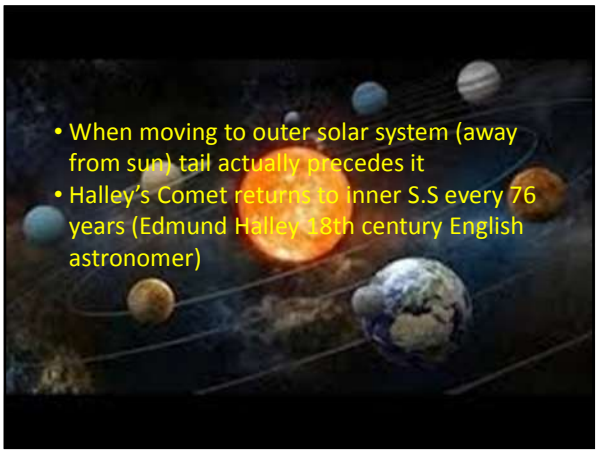
Most distant of Jovian planet
Discovered in 1846
Rotational period 16.1 E hours
165 year orbital period
1989 Voyager 2- magnetic field tipped 47 degrees to axis, offset from core by ~ 13,500km
Scientists think motions of conductive material (possibly water) in middle layers generate magnetic field
HArsh planet- winds 2000km/hr and avg temp -225C
Atmospher mostly H (74%) & He

Typically 9th planet from sun but ever 248 yrs orbit brings it closer to sun than Neptune. (~20 yrs) - most recently '79, returned '99

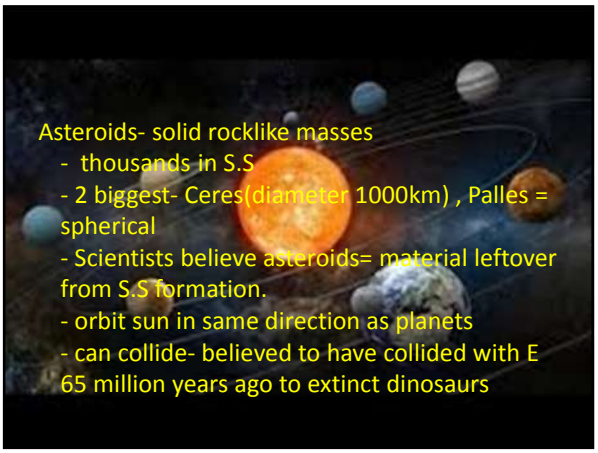
- Smallest planet diameter 2300km (NYC to Houston) smaller than E moon
- Charon- Pluto's moon- half its size (similar so some consider a double planet rather than moon-planet)
- 39.5 AU from sun-- not discovered til '30
- Temp -235 to -210C-- most atmosphere is frozen
- Believe consists of 70% rock, 30% water
- No spacecraft has visited

Comets- dirty snowballs- made of dust trapped in mixture of frozen water, carbon dioxide, methane and ammonia.

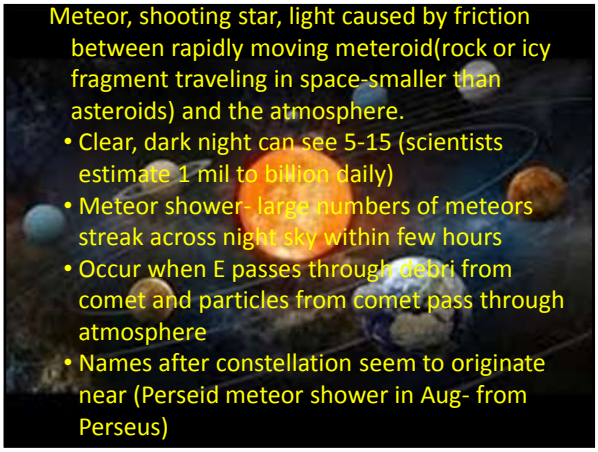
- Most orbit in cold region past Neptune- Kuiper belt (more than 70,000 large- >100km diameter, many smaller)
- Known as Trans Neptunian Objects (TNOs)
- Some orbit in eliptical obrit and can get closer to Jupiter's orbit- visible from E- heated by sun to form coma (cloud of gas, dust) solar winds push coma particles into space making up to millions of km long. (face away from sun)



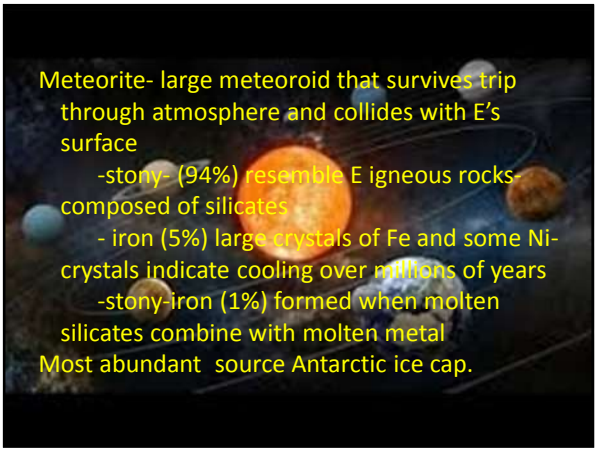
- When moving to outer solar system (away from sun) tail actually precedes it
- Halley's Comet returns to inner S.S every 76 years (Edmund Halley 18th century English astronomer)



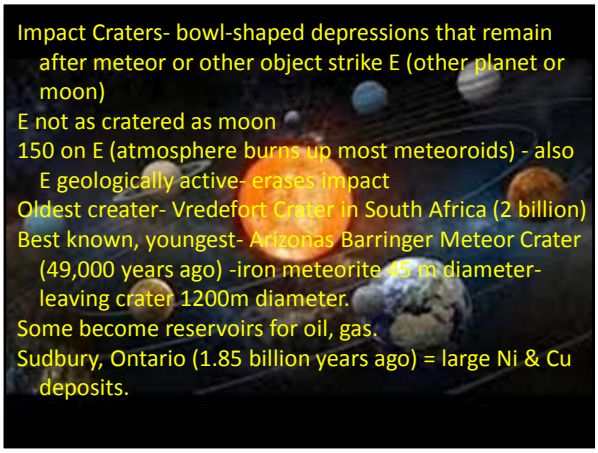
Asteroids- solid rocklike masses
- thousands in S.S
- 2 biggest- Ceres(diameter 1000km) , Palles = spherical
- Scientists believe asteroids= material leftover from S.S formation.
- orbit sun in same direction as planets
- can collide- believed to have collided with E 65 million years ago to extinct dinosaurs



Meteor, shooting star, light caused by friction between rapidly moving meteroid(rock or icy fragment traveling in space-smaller than asteroids) and the atmosphere.
- Clear, dark night can see 5-15 (scientists estimate 1 mil to billion daily)
- Meteor shower- large numbers of meteors streak across night sky within few hours
- Occur when E passes through debri from comet and particles from comet pass through atmosphere
- Names after constellation seem to originate near (Perseid meteor shower in Aug- from Perseus)



Meteorite- large meteoroid that survives trip through atmosphere and collides with E's surface
-stony- (94%) resemble E igneous rocks- composed of silicates
- iron (5%) large crystals of Fe and some Ni- crystals indicate cooling over millions of years
-stony-iron (1%) formed when molten silicates combine with molten metal
Most abundant source Antarctic ice cap.



Impact Craters- bowl-shaped depressions that remain after meteor or other object strike E (other planet or moon)
E not as cratered as moon
150 on E (atmosphere burns up most meteoroids) - also E geologically active- erases impact
Oldest creater- Vredefort Crater in South Africa (2 billion)
Best known, youngest- Arizonas Barringer Meteor Crater (49,000 years ago) -iron meteorite 45 m diameter- leaving crater 1200m diameter.
Some become reservoirs for oil, gas.
Sudbury, Ontario (1.85 billion years ago) = large Ni & Cu deposits.