

## ASTRONOMY I – Space, planets and contents

### I. BIG BANG Theory

- A. Accepted Theory – not proven, but has some limited evidence so support it  
We are not trying to disprove any family or church teachings, but it is important to listen to different view points, weigh the evidence and make a adult decision on what your belief systems are. NYSD Regents requires that this information be presented and tested. This is the information on test that you'll have to be able to answer correctly. Once the Regents is over, you may use your judgements to believe or not believe.

*Materials needed: a big rubber band*

- B. All matter was located in a point source – extreme limitless, infinitive mass
1. mass crushed in on itself and exploded with immense energy outward
  2. all matter continues to move through the universe away from this source point
  3. There is moderate evidence to support this theory
- C. Some believe in a BIG BANG/CRUSH, in which at some point the universe will slow down expansion, stop expanding and then like a **rubber band** return to its original point source. There is little evidence to support this.

### II. Electromagnetic Spectrum (pg 365)(ESRT pg14)

- A. Wavelengths /Energy
1. the smaller the number the faster the wave pattern
    - a. the smaller the wavelength, the more energy is carried
      - 1) gamma rays
      - 2) energy released in radioactive material
      - 3) also released from stars other celestial objects
      - 4) can cause radiation exposure in humans - cancer
  2. the larger the number the slower the wave
    - a. the larger the wavelength the less energy is carried
      - 1) radio waves
      - 2) pass through us all the time and have no effect on us
  3. Discuss different kinds of radiation listed
    - a. x-rays fairly intense waves – bones pictures can not go through denser materials, lead vests etc – does come from some objects in space black holes and stars in particular
    - b. UV – stratosphere – O3 absorbs – skin cancer
    - c. Infra red – green house effect – heat lamps
    - d. Microwaves
    - e. Radio waves
    - f. Visible light
      - 1) ROYGBIV – identify colors
        - a) identify which side has more energy, less energy

- b) discuss red fire flames vs blue
- c)

*Talk about how a emergency vehicle siren sounds as the vehicle moves closer to you, and then passes you. First it raises pitch and then lowers in pitch due to pushing and stretching the sound waves. We are familiar with sound, astronomers use the same principles in space to identify motion of objects.*

4. Doppler Effect
  - a. if space is being stretched – shows longer wavelengths – red shift
    - 1) means the object is moving away from you (BIG BANG)
  - b. if space is being pushed – shows shorter wavelengths – blue shift
    - 1) means the object is moving towards you
  - c. these colors can not be seen by naked eye – they will be seen on some sophisticated machinery astronomers use.

## II. Stars

### A. Apparent vs Absolute luminosity, magnitude

1. Apparent – according to the location of observer
  - a. closer – bigger, brighter farther away – smaller, dimmer
  - b. location in sky due to Earth's position
2. Absolute –
  - a. put all stars side by side how do they compare

### B. Stars Cycle

1. Birth
  - a. Nebulae – nursery – immense amount of gas and dust
  - b. stars accrete (gather mass and gravity- more mass, more gravity)
  - c. appears almost to be put up through a pipe line and birthed
  - d. thousands of stars can be born from a single nebulae
2. Stars generally born Main Sequence – infant to teenage in age sequence
  - a. burn H and He, last several billion years
  - b. Our Sun has burned about 5 bill yrs and is anticipated to stay in this stage for another 5 (10 total)
  - c. dependant on amount of gas held.
3. As stars burn gas, have less mass and then less gravity
  - a. less gravity – cannot hold matter as tightly
  - b. star expands, temperatures decrease - RED GIANT
  - c. luminosity increases
4. As star continues to burn gases, more matter is used up
  - a. gravity decreases – expands can move to a SUPER GIANT
    - 1.) stars can go from Red Giant to nova or white dwarf
  - b. star eventually burns up enough energy/matter collapses upon itself
    - 1) collapse inward to point it can no longer collapse and explodes - NOVA, - immense explosion of light and matter outward – only lasts for a few seconds
    - 2) super giants explode into SUPER NOVA

5. Remains of a star
  - a. white dwarf – fizzled out star w/ small amounts of burning energy
  - b. low luminosity but hot temperatures, high gravity
  - c. as star continues to burn and use fuel – brown dwarf
  - d. very old star that is essentially dead – BLACK DWARF
6. Unusual remains of stars
  - a. neutron star – extreme dense, extreme density
  - b. pulsar – a spinning neutron star w/ hole which streams out radio waves
  - c. black hole – star has collapsed upon itself to immense density, gravitation force is so high that even light cannot escape from the hole. X-rays spiral into the hole which can be seen with an X-ray telescope – take pictures of these locations – time actually changes on the event horizon as objects spiral in.

*Discuss Hertzsprung -Russel Diagram showing locations of stars – located on ESRT. Do Properties of Stars Lab – graph stars*

### III. Constellations:

- A. Define – a group of stars that sketch out pictures in the sky.
  1. Circumpolar – constellations or stars that circle around the north pole (Polaris)
    - a. since the stars are so far away, in relation to Ea they don't move
    - b. Our axis sits below Polaris, and we rotate, so star trails appear to circle Polaris to us.
    - c. The “North Star” has changed over time due to the Ea's wobble. Several million years ago, the polar axis star wasn't Polaris, and in a few million years, another star will take the north position.
  2. Major circumpolar constellation – Ursa Major – The Great Bear, The Big Dipper. Ursa Minor – The Little Bear or the Little Dipper, Cassiopeia- The Queen, Cepheus- The King.
  3. Constellations will appear to move in & out of our vision due to our seasons.

*Have one student go to front of the class and model the Ea. As the Ea rotates, the position of each constellation changes in relation to the Ea position. (The stars did not move – we did! The kid's face is daylight hours, some constellations can be seen during the night, others can't be seen because they are visible only during the day (or not visible))*

### *Do Constellation Lab*

*Use celestial sphere. Have kids look at it as a class identifying favorite constellations. Have them note not all constell. Can be seen all the time. Some constellations are particular to the Northern Hemisphere – others to the Southern Hemisphere. Vision can only be 180degrees from skyline to skyline.*

## IV. Our Sun

A. Main Sequence Star – very average

B. Structure –

1. photosphere – main yellow section of star
  - a. made of granules – individual convection cells on sun, appears the surface is boiling – cells are very short lived
2. chromosphere – 1<sup>st</sup> layer off surface of sun above photosphere
  - a. color sphere – generally red
3. corona- only seen on outside of sun – seen during a total eclipse

C. Sunspots: cool circulation cells on Sun's surface

1. always occur in pairs
2. rotate across sun's surface
3. last hours to months
4. occur in greater numbers during solar maximums w/ flares & prominences.
5. telecommunications are disrupted during solar maxs due to solar wind
  - a. solar wind – magnetic particles that fly from the sun, affects Earth's magnetic force lines “excites” particles
  - b. also shows in Northern Lights – aurora borealis

## V Our Moon

A. Origin & Structure

1. formed about 4.6 billion y.a.
2. Theory 1 Ea was still v.young and not totally solid. Collision w/ a large object (planet size) part of Ea broke off and solidified with orbit around Ea.

Theory 2: During Ea's formation our gravitational force attracted another object, got caught in revolution cycle.

3. Lunar rock contain no water, ages 3.1-4.6 y.o.
4. Light portions of the moon are up/high lands – raised land forms : ie mountains, hills etc,
5. dark portions- lowlands
6. Large craters formed from meteorites/ debris hitting. No atmosphere therefore, space debris does not burn on the way through

B. Moon's Orbit

1. 27 1/3 days in length, 5 degrees off of Ea's orbit
2. Moves 13 degrees Eward on orbit (rises 50 minutes later each day)
3. Takes 29.5 days between new moon and new moon because as moon revolves around Ea, Ea revolves around Sun and the moon has to play “catch up” since the Ea moved along its orbit.

C. Moon Phases

1. waxing / waning – building, weakening
2. ½ of moon is always lit, but the lit part is not always seen completely from Ea.
3. eclipses – the piece that is shadowed in the part eclipsed
  - a) solar eclipses – the moon is blocking the Ea's vision of the Sun.

- b) lunar eclipses – the Ea’s shadow is blocking the moon.
- 4. umbra – darkest part of the shadow
- penumbra – lightest part of the shadow

#### D. Tides

- 1. Law of gravitational attraction: moon pulls on the fluid water – high moon’s pull lowers water level on 90degree ocean location – low Moon also pulls on water and Ea and leaves water behind – high
- 2. Every 6 hours and 13 minutes changes from H → L
- 3. Spring tides – sun and moon pull together, extra high tide  
Neap tides - sun and moon pull opposite (90 degrees) extra low tide

### VI. Comets & Asteroids & Meteorites

#### A. Comets

- 1. structure
  - a. mostly empty space, ice and dust
  - b. head or nucleus
  - c. tail, particles released, burned off
    - 1) blows w/ solar wind
  - d. visible due to light reflection
- 2. orbit very elliptical
  - a. swing beyond Pluto and back into the sun
  - b. Halley’s comet revolution 76 yrs
  - c. Hal Bop

#### B. Asteroids

- 1. solid, rock like mass w/irregular shapes
  - a. possibly debris left from solar system formation
  - b. extinct comet caught in orbit
- 2. too small to be a planet
  - a. Pluto is actually now thought a large captured asteroid
  - b. tried to declass from planet status – did not
- 3. Asteroid Belt
  - a. between Mars and Jupiter
  - b. hundreds of miles in between pieces

#### C. Meteor, meteorites

- 1. debris traveling in space
- 2. can be any size
- 3. burns, usually incinerates as it enters the Ea’s atmosphere
  - a. if large enough to hit surface – meteorite
  - b. types
    - (1) 93% are stones
    - (2) irons
    - (3) stony irons
    - (4) most found in Antarctica, frozen stored in ice
    - (5) crater
- 4. 100 million enter Ea’s atmosphere daily
- 5. dust and gas from space and a few tons each day

## VII Planets

### A. Geocentric Theory

### B. discovered by retrograde motion

### C. Johannes Kepler – Laws of Planetary Motion

#### 1. Elliptical Orbits

- a. 2 foci, the Sun being one
- b. aphelion – farthest away
- c. perihelion – closest
- d. see ESRT

#### 2. Equal Area Law

#### 3. Harmonic Law

- a. further a planet is the longer its revolution
  - 1) orbit is larger
  - 2) velocity is slower

### D. Newton's Law of Gravitational Attraction

1. Force between 2 objects related to masses of 2 objects

### E. Planets

#### 1. Terrestrial, like Ea, land based

##### a. Mercury

- (1) impact craters
- (2) no atmosphere, too hot, burns off

##### b. Venus

- 1) Ea's twin
- 2) morning or evening star
- 3) weak magnetic field
- 4) rotates E-> W (backwards)
  - a) big hit, upside down
- 5) volcanic features, impact craters
- 6) high CO<sub>2</sub>, w/ sulfuric acid clouds
  - a) greenhouse effect
- 7) pressure is 90X Ea

##### c. Mars

- 1) 4 seasons due to tilt like Earth's
- 2) atmosphere CO<sub>2</sub> mostly
- 3) 1/150<sup>th</sup> of Ea's pressure
- 4) polar ice caps
- 5) evidence of water erosion
- 6) primitive (dead) bacteria found in ice
- 7) volcanic

#### 2. Jovian Planets, gaseous, big

##### a. Jupiter

- 1) a star that did not completely undergo fusion
  - a) gives off energy more than receives from Sun
- 2) alternating bands parallel the eq.
- 3) high winds
- 4) Great Red Spot

- a) turbulent, violent ongoing storm?
- b) calm area rotate slowly?
- 4) 18 moons
- b. Saturn
  - 1) color bands, rising/sinking gases
  - 2) weak magnetic field
  - 3) rings gas and dust
  - 4) 20 moons?
- c. Uranus
  - 1) orbits the Sun on its side
    - a) immense impact tipped it
  - 2) atmospheric currents
    - a) whole planet is equal temperature
    - b) 15 moons
- d) Neptune
  - 1) very high winds
  - 2) gives off more energy than receives from sun
  - 3) 8 moons
- e) Pluto
  - 1) water, ice, rocks
  - 2) orbit comes closer to the sun than Neptune
  - 3) 1 moon