Name____Date_______________________

Hyperspace: Star stuff

1. Who is the narrator? Where does he claim we came from? Where have you seem him before?
2. What is the moment that the universe began called?
3. What was the initial cloud made of?
4. What are scientists studying to learn more about what the big bang might have been like?
5. What is the energy that keeps stars burning?
6. What happens inside of a star to create what we need for life?
7. What is it called when a star blows itself apart? How long does it take?
8. What does Drake use to generate the amount of energy in the explosion of a star?
9. How big is the instrument that is used to tear the tiny version of the star apart?
10. What was the name of the supernova that they were able to capture on film in 1987?
11. True or False, Our sun is the biggest star in the universe?
12. One Theory of how life got to Earth is that it hitched a ride on what?

Are we Alone:

1. How many species live on the planet Earth?
2. How many stars make up our Galaxy the Milky Way?
3. What is SETI and what does it stand for?
4. What did SETI detect in 1977 that they had been looking for?
5. Where is the largest telescope in the world, what are they looking for?
6. What can scientist find by looking for a wobbling star?

7. About how many new planets are scientists finding per month?

8. Why do they think that alien life on these planets so far is impossible?

9. What is the goal of the laser guided satellite system that will be launched in 2025?

10. What extreme environments have we found life unexpectantly existing in on Earth?

11. What well-known planets/moons would make good candidates for life?

12. How would intelligent life be able to detect us?

Looking Out Is Looking Back...in a VERY Big

In today's world, travel is made easy by jet aircraft, high-speed trains, and interstates on which cars may travel at high rates of speed. If you have relatives in a city 200 kilometers away, you can be at their house in only 2 hours by car if you travel at a speed of 100 kilometers per hour. How do we know this? By using the formula t = d/r (where t = time, d = the distance traveled, and r = the rate at which we travel), we can calculate our travel time. Let's investigate!

1. What if those relatives that you wanted to visit lived 400,000 km away on the Moon? How long would it take to get to their house if you traveled by car at 100 km/hr?

2. The distance that you must travel to get to a lunar relative's house is nothing compared to the distance you must cover in order to visit a relative on Pluto. Pluto is 6,000,000,000 km from Earth. If you travel at 100 km/hr, just how long would it take you to reach our most distant planet? There are only 8760 hours in a year. How many years would it take you to reach Pluto? (You must REALLY like these relatives a lot!)

3. Perhaps we could reach Pluto in a more reasonable amount of time if we journey by jet. A jet travels at 1000 km/hr. At this faster speed, what is our travel time to Pluto? How many years will it take us?

Once you get outside of our solar system, the distances between objects become absolutely astronomical! It would be very difficult to do mathematical calculations using such large numbers. Scientists therefore rely on a unit called a **light-year** to describe the distance between the farthest objects in our Universe. A light-year is equal to 9,500,000,000,000 (9.5 trillion) km and is the distance that light travels in one year. A light-year can be expressed in scientific notation as 9.5×10^{12} km.

4. The star outside of our solar system that is closest to Earth is Alpha Centauri C. It is 40,000,000,000,000 (40 trillion) km away. How many light years is that? If we hopped aboard our jet, how long would it take us to get to Alpha Centauri C? How many years would that take? (Can you imagine what you'd need to pack?)

5. As an extra challenge, calculate the time it would take to reach Betelgeuse, a red giant located 600 light years away. Traveling at 1000 km/hr. By jet, how long would it take to reach Betelgeuse? How many years is that? Did you know that by the time you got there, Betelgeuse would no longer be the red giant we know today? Betelgeuse is in the dying phase of its lifecycle. With a mass 1000 times that of the Sun, if Betelgeuse was put in the middle of our solar system it would extend all the way out to Jupiter's orbit! As a supermassive star, the next step in Betelgeuse's lifecycle will be a supernova. This is expected to occur within the next 10,000 years. (Maybe this trip is not well advised!)

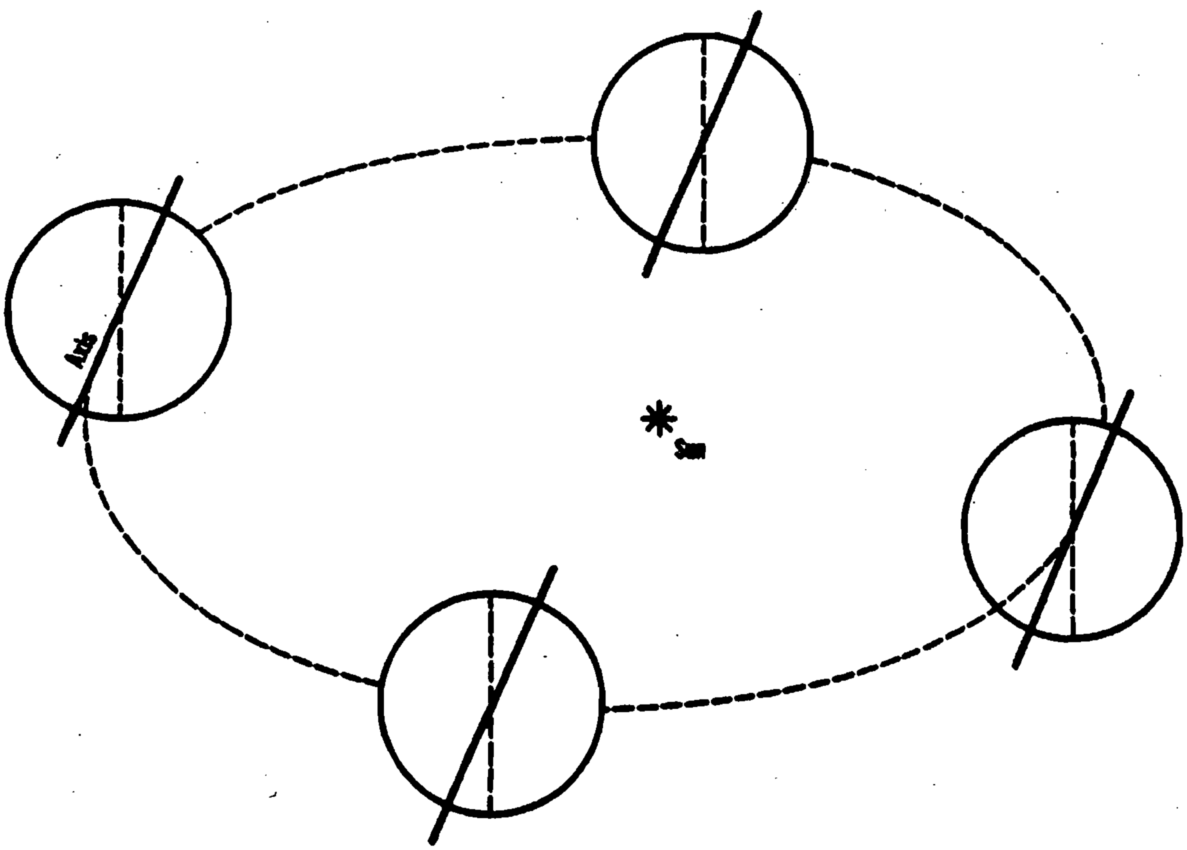
NAME . . . . CLASS . . . . . . DATE . . . .

Activity 20-A. The Seasons

Introduction: In this activity you will study what causes our seasons. The accompanying diagram shows the earth in four positions which correspond to the four seasons. The size of the earth and the shape of its orbit are greatly exaggerated. Working with this diagram will help you to understand the seasons by enabling you to visualize the position of the earth in space that causes each of the seasons.

Directions:

1. Draw and label on each position of the earth the following: *equator, Arctic Circle, Antarctic Circle, Tropic of Cancer,* and *Tropic of Capricorn.*
2. Indicate *summer* and *winter solstices, vernal* and *autumnal equinoxes,* and the dates of each.
3. Shade the areas of the earth on the diagram that are in darkness on the above dates.
4. Indicate the position of the earth at the times of *aphelion* and *perihelion.* Label the dates of these positions and the distance from the sun on these dates.
5. Show with arrows the directions of revolution and rotation.



ACTIVITY QUESTIONS

1. Explain what is meant by the earth's orbit. . . . .

. . . .

2. What is the shape of the earth's orbit? . . . .

3. What is the direction of the earth's revolution? . . . .

4. Where does the vertical ray of the sun strike the earth on June 21? . . . .

. . . .

5. How much of the Antarctic Circle is in darkness on June 21? . . . .

6. How much of the Equator on this diagram has daylight on June 21? . . . .

7. What is the *relative* length of day and night at your home on June 21? . . . .

. . . .

8. Where does the vertical ray of the sun strike the earth on December 21? . . . .

. . . .

9. What is the *relative* length of day and night at your home on December 21? . . . .

. . . .

10. What would be the effect on summer and winter at your home if:

    (a) The angle of inclination were more than 23½ degrees? . . . .

    . . . .

    (b) The angle of inclination were less than 23½ degrees? . . . .

    . . . .

11. What would be the effect on the seasons if the axis were perpendicular to the plane of orbit? . . . .

12. What is meant by:

    (a) Perihelion? . . . .

    . . . .

    (b) Aphelion? . . . .

    . . . .

13. Explain why the seasons change. . . . .

. . . .

. . . .

NAME . . . . CLASS . . . . . . DATE . . . .

Activity 19-B. Eclipses of Moon and Sun

Introduction: In this activity you will study in detail eclipses of the moon and of the sun. In particular, you will make graphical representations of the shadows cast by the earth and by the moon when they are in the proper position with respect to the sun to cause a lunar or a solar eclipse.

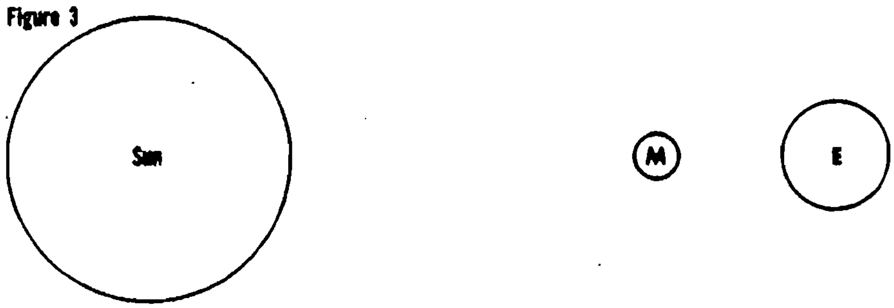
Directions:

1. On figure 1, draw two external tangent lines from the sun to the earth and continue them until they meet, thus forming the earth's *umbra*. Draw two internal tangent lines from the sun to the earth and continue them, thus forming the earth's *penumbra*. Shade and label the umbra and crosshatch and label the penumbra. Indicate with a circle the moon's orbit and show its direction of revolution.
2. On figure 2, draw two external tangent lines from the sun to the moon and continue them until they meet, thus forming the moon's umbra. Draw two internal tangent lines from the sun to the moon and continue them, thus forming the moon's penumbra. Shade and label each shadow as in figure 1. Indicate with a circle the moon's orbit and show its direction of revolution.
3. On figure 3, draw two external and two internal tangent lines from the sun to the moon as in figure 2. Shade and label each shadow. Indicate with a circle the moon's orbit and show its direction of revolution.

Figure 1

Figure 2

Figure 3



ACTIVITY QUESTIONS

1. What kinds of eclipses are shown in figure 1? . . . .

2. At what phase of the moon does a lunar eclipse occur? . . . .

3. **(a)** Is there an eclipse every time this phase occurs? . . . .

(b) Why? . . . .

4. **(a)** Under what conditions will an eclipse of the moon be total? . . . .

. . . .

(b) Under what conditions will an eclipse of the moon be partial? . . . .

. . . .

5. From what portion of the earth can each lunar eclipse be seen? . . . .

6. What kinds of eclipses are shown in figure 2? . . . .

7. At what phase of the moon does a solar eclipse occur? . . . .

8. Why can a total solar eclipse be seen on only a small portion of the earth? . . . .

. . . .

9. In what direction does the shadow of the moon move across the earth? . . . .

10. What kind of eclipse is shown in figure 3? . . . .

11. **(a)** Is the shadow of the moon always long enough to reach the earth? . . . .

(b) Why? . . . .

12. At what phase of the moon does an annular eclipse occur? . . . .

13. Show by a freehand drawing how the sun appears from the earth as seen from the center of an annular eclipse.

Moon Activities - computer	Per	Names

Directions:

1) Go to website http://science.howstuffworks.com/question491.htm
Click on the figure of the person on the bottom right of the picture around and see what happens.
- When does the figure look bigger?________________________________.
- When does the figure look smaller?_______________________________.
- What is it called when things look bigger than they really are?________________.
- Is the moon actually bigger when it is close to the horizon?___________________.

2) Go to website : http://www.jackstargazer.com/cartoonFeb03.jpg
- What images may you be able to see on the moon?______________________
____.
- What do you think causes their to be "images" on the moon?______________
____.

3) Go to website : http://www.tsgc.utexas.edu/everything/moon/calculator.html
Type in your weight in the first box and click on the calculate button to see how much you would weigh on the moon.
- Your weight_________________ Your weight on the moon___________________.
- If you went to the moon, would you have less mass?_______________________.
- Why would you weight less on the moon?______________________________
____
____.

4) Go to website : http://www.astro.wisc.edu/~dolan/java/MoonPhase.html
Click on "both views" in the drop down box and click the "animate" button.
- Describe what you see happening.______________________________________
____
____.

5) Go to website : http://csep10.phys.utk.edu/astr161/lect/time/moonorbit.html
- How many days does it take the moon to make a revolution around the earth?
____
- How many days does it take the moon to make a rotation on its own axis?
_____________________________.
- How many side of the moon does one see on earth?_____________________

6) Go to website : http://www.niehs.nih.gov/kids/lunar/home.htm
Scroll down to the page that displays the pictures of the moon surrounding the earth.
- Why do we see different phases of the moon? (hint: the answer is about the diagram)
____
____
____.

7) Go to website : http://aa.usno.navy.mil/faq/docs/moon_phases
- Draw and label the 8 phases of the moon shown on the website.

8) Go to website: http://tycho.usno.navy.mil/vphase.html

In the drop down boxes, change the dates to match your birthday for this year

- Draw a sketch of the moon phase on your birthday. Label the phase.

- Draw a sketch of the moon phase that will be on your birthday next year. Label the phase.

9) Go to website : http://science.howstuffworks.com/solar-eclipse.htm

- What is a solar eclipse?____
____
____.
- How many times does the moon cross the earth's orbital plane a year?_________________
- What phase must the moon be in for an eclipse to happen?___________________________.
- Since the moon makes a revolution around the earth every 27.3 days, why isn't there a solar eclipse every 27.3 days?____
____
____.

10) Go to website: http://www.mreclipse.com/Special/LEprimer.html

- What is the diameter of the moon?____.
- What is special about a full moon?____

____

____

____.

- What two things must happen for a lunar eclipse to occur?_________________________

____

____

____.

- If there were astronauts on the moon during a total lunar eclipse of the earth, what would they see on the moon?____

____

____.

11) Go to website : http://aa.usno.navy.mil/data/docs/LunarEclipse.html

In "form A" Choose PA in the drop down menu

Type in Philadelphia in the "place name.

Choose the appropriate date in the first drop down box.

Fill in the times that the event takes place ,in the data table below, for the next 3 lunar eclipses.

	12/10/11	12/21/10	6/26/10
Moon enters umbra			
Middle of eclipse			
Moon leaves penumbra			

12) Go to website : http://www.jackstargazer.com/cartoonOct02.jpg

- Describe what happens to the stars during the seasons.

____

____

____

____

____

____.

- Is there a star that you see all year long? If so, which one is it?__________________

____.

Parallax

Names ________________________

____

Purpose
The student will explore parallax, a primary distance measuring technique.

Materials

Meterstick

Background and Theory

One of the most difficult problems in astronomy is determining the distances to objects in the sky. There are four basic methods of determining distances: radar, parallax, standard candles, and the Hubble Law. Each of these methods is most useful at certain distances, with radar being useful nearby (for example, the Moon), and the Hubble Law being useful at the most distant scales. In this exercise, we investigate the use of parallax to determine distances.

Even when observed with the largest telescopes, stars are still just points of light. Although we may be able to tell a lot about a star through its light, these observations do not give us a reference scale to use to measure their distances. We need to rely on a method with which you are actually already familiar: the parallax.

You can see the parallax effect by holding your thumb out at arm's length. View your thumb relative to a distant background while you alternate opening and closing each eye. Does your thumb seem to jump back and forth relative to this background? This is because the centers of your eyes are a few centimeters apart, so each eye has a different point of view.

Procedure

1. Let's test how the parallax of an object varies with distance.
    a. One partner takes the meterstick and places the pencil at the 50 cm mark, centering the pencil on the meter stick. The other partner places the "zero" end of the meterstick against her/his chin, holding it out horizontally. This partner then alternates opening and closing each eye, noting how the pencil moves against specific background objects.

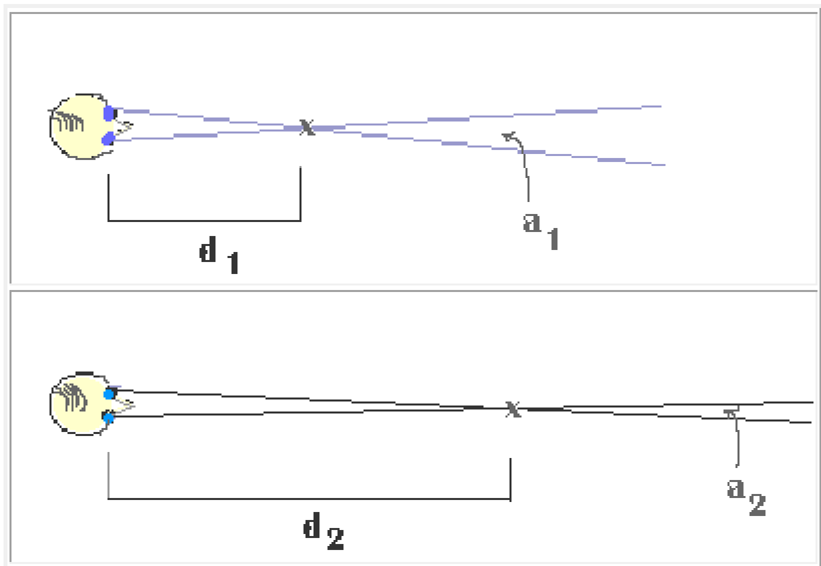
    Describe how the pencil moved against background objects:

    b. Have your partner move the pen half of the original distance (to 25 cm). When you alternate opening and closing each eye does the pen appear to move more or less than before? Try to quantify how much more or less (twice as much? half as much? three times as much? etc.).

    c. Now, have your lab partner move the pen twice the original distance to you, to approximately the end of the meterstick. When you alternate opening and closing each eye does the pen appear to move more or less than before? Try to quantify how much more or less (twice as much? half as much? three times as much? etc.).

The parallax of the pencil depends on the distance the pencil is from you -- the closer the object, the larger the parallax. Thus, although it may have been hard to tell precisely, when the pencil was half the original distance from you, it had twice the parallax; when it was double the original distance from you, it had one-half the parallax.

2. Here is a look at the approximate relationship between distance and parallax from a different viewpoint, from above the observer.



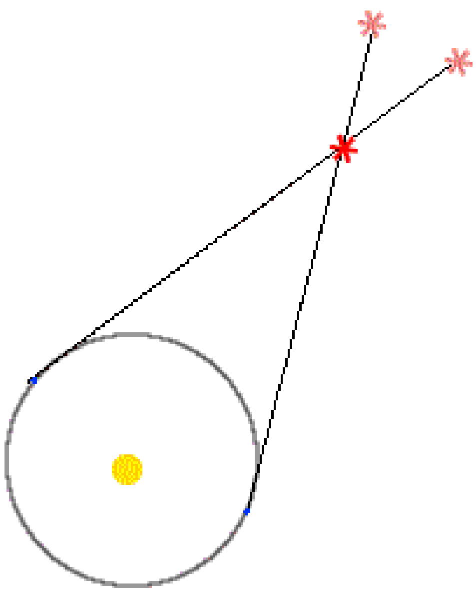
- The distance $\mathbf{d_2}$ is twice the distance $\mathbf{d_1}$. Does it qualitatively appear that angle $\mathbf{a_2}$ is one-half of $\mathbf{a_1}$?
- When the distance is large enough that the parallax **angle** is very small, the parallax angle is proportional to the inverse of the distance (**1/d**). Conversely, if we can measure the parallax angle, we know that the distance to the object is proportional to the inverse of that angle.

3. There is a limit at which parallax becomes ineffective. This occurs when the parallax angle is so small that you can't see a change from one eye to the other. This distance is effectively infinity. You and your partner can find your personal infinity by taking the pencil farther and farther away from the observer until the parallax becomes undetectable.
   . One of you should take the role of "observer" while the other walks straight away, holding the pencil out at arm's length, stopping every meter or so. The observer should alternate opening and closing each eye as the partner stops. How far away are you from each other when the pencil stops moving relative to even more distant objects?

   a. What can you determine about the usefulness of parallax at different distances?

4. To measure a parallax, you use a baseline: the distance between observation points. In the exercise above, the "baseline" is equal to the distance between the center of your eyes. Measure this distance for you and your partner. Compare these two numbers to the distances found in Step 3a. Is there a relationship between the two sets of numbers?

5. In astronomy, we use a "baseline" of the diameter of the Earth's orbit. The infinite background is made of stars much farther away than the star or object in question. We can measure accurate parallaxes of thousands of stars; unfortunately, most stars are simply *too far* to get an accurate parallax, and we must resort to other methods to determine their distances. Label the following on the image on the worksheet: Reference star(s), target star, Earth, Sun, dates of observation (choose one, then find the other consistent with that choice).



6. Technology improves all the time, and our options for choosing a baseline may be expected to expand. Which of the following scenarios would give the longest baseline for measuring parallax (and therefore would be most desirable)? Which is most feasible with today's technology? Why?

    a. A satellite orbiting high above the Earth.
    b. A telescope on the Moon.
    c. A satellite orbiting Jupiter.
    d. A satellite orbiting Pluto.

Name __________________
Period_____________

Student Notes

Vocabulary: Define each term below in a complete sentence on a separate sheet of paper. (Those that are *, please illustrate next to the definition)

Universe	Constellation*	Rotation*
Celestial Sphere*	Celestial Poles	Celestial Equator
Solar Day	Sidereal Day	Revolution*
Ecliptic	Zodiac*	Seasons
Summer Solstice*	Winter Solstice	Vernal Equinox
Autumnal Equinox	Penumbra*	Umbra*
Synodic Month	Sidereal Month	Sidereal Year
Precession*	Lunar Eclipse*	Solar Eclipse*
Astronomical Unit*	Annular Eclipse	Triangulation
Star	Parallax*	Light Year*
Satellite*	Scientific Notation	Milky Way Galaxy*

Charting the Heavens

A. Our Place in Space
  1. Two periods of scientific revolution in the field of astronomy
     a. 1st revolution- _____________, Kepler and ____________, 17th century, discovered Earth is not the center of the Universe as previously thought
     b. 2nd revolution- __________________________

B. The Scale of Things
  1. The Universe- the totality of all space, time, matter and energy
  2. A light year- the distance traveled by light or _________________________in one year (1 mile= 1.6 kilometers, how many miles is a light year? _________________________)
     a. Another question, how long would it take to count to 1 trillion miles at a rate of 1 mile per second
  3. Scientific Notation- in science the numbers used to measure certain values are abbreviated because the values are so small or so large, for example 1 would = = 1.0 x 10^0 while 1,000 would = _____________ , for very small numbers such as .0003 then the value would = ________________
     a. Let say you have an object 630,000,000 meters from Earth, in scientific notation this would = ______________________
     b. You try some, change the values to or from scientific notation depending on the value:
        1) 10,000,000 = ______________________
        2) 540 = _______________________
        3) 1.0 x 10^7 = ___________________
        4) 1.0 x 10^{-7} = ___________________
        5) 4.6 x 10^9 = ___________________
  4. Distances within the solar system are expressed in astronomical units (A.U.), the mean distance between the Earth and the Sun or 150,000,000 km, 1.5 x 10^9 km
  5. On larger scales light years or parsecs (3.26 light years) are used

C. The Obvious View
  1. Constellations in the Sky

a. From sunset to sunrise, approximately _______________ can be seen with an unaided eye
b. Constellations- the brightest stars are connected by people since throughout human history after ________________________ such as animals and gods
   1) The stars in a constellation are not actually close to each other, in space the stars can be great distances from each other (see page ______, Orion)
   2) There are approximately __________ constellations that can be observed from Earth
c. _____________ or the North Star in the little dipper has been used for navigation by sailors, other constellations serve as calendars of when to ____________________
d. Constellations serve as the foundation for the science of astronomy, ________________ (not a science) uses the relative positions of stars and planets to make predictions about a person's future (have you checked your horoscope today?)

2. ____________________________-a canopy of stars representing a night time 'ceiling' from Earth
   a. Stars rise in the _____________________________ (just like the sun), all stars rotate around Polaris (see picture _____, page ____)
   b. The celestial sphere does not move, what you are witnessing when you see stars move is the Earth rotating
   c. See page ___, figure _____ for illustrations of terms below
      1) ____________________- point where the Earth's axis intersects the celestial sphere in the Northern Hemisphere (directly above the north pole)
      2) South celestial pole- point where the Earth's axis intersects the celestial sphere in the Southern Hemisphere (directly above the south pole)
      3) _____________________- represents the intersection of Earth's equatorial plane with the celestial sphere

D. The Motion of the Sun and the Stars
   1. Day-to-Day Changes
      a. _____________________- the daily progress of the Sun and the other stars across the sky, the celestial sphere at night is different than the one during the day
      b. _____________________= 24 hours (from one sunrise to the next)
      c. ____________________ (Latin for star) day= 23 hours 56 minutes (the position of the stars from one night to the next)
         1) The position of the stars are in slightly different positions from the previous night due to the revolution of the Earth, each time the Earth rotates it also is revolving around the sun
         2) As the Earth revolves around the sun along its orbit, it changes position in space, so our view of the stars changes slightly each night (see figure _____)
   2. Seasonal Changes
      a. ________________- the apparent motion of the sun in the sky expressed relative to the stars (figure ____________), the sun goes around a circle on the celestial sphere inclined at an angle of 23.5 degrees to the celestial equator (takes 365.242 solar days for one circuit= one tropical year). The sun in not at an angle, this is the Earth's ________ towards the sun
      b. Key terms:
         1) _____________________- when the Earth's North Pole points closest to the Sun, usually around June 21st (when the sun is highest in the sky over Bucks county, longest day of the year)

2) ______________________- when the Earth's South Pole points closest to the Sun, usually around December 21st (when the sun is lowest in the sky over Bucks county, shortest day of the year)
   a) The ____________________ over the horizon and the ____________________ account for the seasons, the higher the sun and the longer the day= warmer temperatures, the opposite for the winter solstice.
3) _________________- when the ecliptic intersects the celestial equator (figure _____)
4) ____________________- when the sun crosses from the Northern into the Southern Hemisphere (on September 21st)
5) ___________________ occurs when the sun crosses from the Southern into the Northern Hemisphere (on March 21st, first day of spring)

3. Summer and Winter Constellations
   a. During each season, certain constellations appear in the night sky (see page ____)
   b. In the summer you can see Sagittarius and Capricorns and bright stars such as ________
   c. In the winter you can see _________, Leo and Gemini
   d. The change in direction of constellations from one night to the next is _______________, in 6 months you will see entirely different constellations then you see tonight.
   e. Sidereal year- the time required for the constellations to complete on cycle around the sky and to return to their starting point= 365.256 solar days, about ________________ longer than one tropical year

E. Celestial Coordinates
   1. Two methods of locating stars in the sky, the first is by constellation and brightness of stars in them
   2. For more precise measurements, astronomers use ___________________________ (similar to latitude and longitude but in the sky)
      a. Instead of latitude and longitude, astronomers use ________________________________
      b. Declination is measured in degrees north or south of the ________________________, the north celestial pole is at + 90 degrees while the south celestial pole is at –90 degrees and the celestial equator is at 0 degrees
      c. Right ascension is measured in ________________________, it increases in the eastward direction, this is to represent time and the rotation of the Earth, in one hour the Earth rotates 15 degrees (360 degrees/24 hours) or 1 hour
      d. Although stars appear to move across the night sky, their coordinates remain constant over the night sky, what are the coordinates for the star Betelgeuse? See figure 1.13

F. The Motion of the Moon
   1. The moon is the second brightest object in the sky, it doesn't ___________________ only reflecting sunlight towards the Earth
   2. The moons goes through phases along a regular cycle of ____________ (see page ______)
      a. _____________- invisible in the sky, starting point where we see the moon grow or 'wax' each night
      b. _________________- one week after the new moon, half of the lunar disk can be seen
      c. ______________-- two weeks of 'waxing' we seen the entire lunar disk
      d. ______________- only a small portion of the moon is illuminated, either a waxing or waning (shrinking)
      e. ____________________- portion larger than a quarter moon, either waxing or waning
   3. Just like the motion of the Earth and the Sun, the moon and the Earth follow similar motions

a. __________________- 27.3 days, the moon returns to the starting point on its celestial sphere
b. __________________- 29.5 days longer than the sidereal day for the same reason as why a sidereal day and a solar day differ (see figure 1.15)

G. Eclipses
1. Once and a while the sun and the moon line up precisely at a ________________ and we can witness an eclipse.
2. Lunar eclipse- When the sun and moon are in exactly opposite directions as seen from Earth, _____________________ sweeps across the moon temporarily blocking the Sun's light and darkening the moon (see figure 1.16)
   a. Most of the time the alignment of the Sun, Earth, and Moon are not perfect so we only see a ____________________, total eclipses are rare
   b. Lunar eclipses appear _______ due to refraction of light from the sun through the Earth's atmosphere
3. Solar eclipse- when the moon passes directly in front of the sun during the middle of the day, so sunlight can totally disappear (see figure _____________)
   a. Total solar eclipses are very rare because the moon can only cast a shadow ____________ wide
   b. ________- central region of the shadow, where the eclipse is total
   c. _______________- outside shadow where only a partial solar eclipse can be seen
   d. ____________________- the moon's orbit isn't circular but rather elliptical, so sometimes the moon is too far away during a solar eclipse for the umbra to reach the earth's surface (figure 1.17 b)
4. Eclipses are rare because the moon's orbit in inclined at an angle of __________ degrees to the ecliptic

H. The Earth Moves
1. ______________________- over time, Earth's axis changes its direction over the course of time but remains 23.5 degrees, this is caused by the gravitational pull of the Moon and the Sun, a complete cycle take about 26,000 years.
2. Remember how there is a 20 minute difference between a tropical year and a sidereal year, if we used the sidereal year the seasons would gradually move around the year (i.e. winter in August)
3. In ____________________ years Orion will be a summer constellation, instead of in the winter

I. The Measurement of Distance
1. Looking at the night sky with the naked eye, an observer cannot determine accurately how far away stars truly are.
2. _____________________- geometric process of finding two spots to find the distance to a star (see figure _______ for a good illustration)
   a. Triangulation is easy to use for _________________________________ but for distant objects in space photographs of the object from different spots on Earth are needed.
   b. After the two photographs are compared the object can be seen in different spots relative to more ____________________ behind the object (see figure ______, page _____), this is called parallax
   c. Try the pencil example on page ______ to better grasp parallax