Spring 2015 Name__________________________Class Time_____________

This is your third assignment using the *Starry Night* software.

This is due in class by Tuesday, March 17th.

You may turn this in any time prior to the due date. Homework is due at the start of class. **Late homework is not accepted!** If you will be unable to make it to class to turn this in, you must give it to me before the end of class on the day it is due. **It will not be accepted if turned in at the mailboxes in the administration building!**

Remember, although you may discuss these exercises with other students, the work you hand in should be your own. Students who turn in answers which are substantially the same as those of other students will receive between 0 and 50% of the points they would otherwise score.

This homework is extra credit.

Exercise A2: Earth's Revolution around the Sun. In this exercise you will see how the part of the sky which is visible at night changes as the Earth orbits the Sun in its yearly cycle.

Open the **SkyGuide** pane, and navigate to
Student Exercises > A: Earth, Moon and Sun
> A2: Earth's Revolution Around the Sun

Question 1a: Go to 1: Night sky changes daily. You see the star Vega on the meridian, which is defined to be directly south. East is to the left, and west is to the right. Note the time. Advance the time by one **day** (exactly 24 hours). You can do this with the "step time forward" button (▌►) which is set to one day increments at this point. You can also highlight the day of the month and use the up/down arrow keys on the keyboard to advance the day. After advancing time by one day, is Vega back to the same spot on the meridian; is it east of the meridian; or is it west of the meridian?

Question 1b: Highlight the "minutes" in the “Time and Date” area and step time forward or backward in one minute steps (using the up/down arrow keys on the keyboard) or change the “Time Flow Rate” to “minutes” and use the "step time forward" button (▌►) or its reverse (◄▌) until Vega is approximately on the meridian. By how many minutes did you have to change the time? Earlier or later?

Question 1c: The times of rising and setting will undergo the same daily change as the time of meridian crossing. Based on your answers to the questions above, do stars rise and set earlier or later each day? [Hint: in 1b, does Vega cross the meridian earlier or later each day?]

Question 1d: The time for any fixed point on the sky to return to the meridian is known as a sidereal day (the day by the stars). It is different from the time for the Sun to cross the meridian, the solar day. The solar day differs from the sidereal day because the Earth is orbiting the Sun; you will learn about the solar day in the next exercise.
(1) Based on when Vega crosses the meridian the second time is the sidereal day longer or shorter than the solar day. (2) What is the approximate length of the sidereal day (in hours and minutes)?

Question 2a: Go to 2: Constellations shift throughout the year. The constellation Pisces is on the meridian at midnight on September 30. Use the "step time forward" button (▌►) to advance by one month (or highlight the "month" and step forward one month with the arrow keys on the keyboard). **Keep the time the same!** (1) Is the constellation Pisces east or west of the meridian? (2) Does that agree or disagree with your answers to question 1?

Question 2b: Step time forward until Pisces is back on the meridian at midnight. You can use a star or even the word "Pisces" to get it back very close to the starting point. Advance by months until you are close and then advance by days. To advance by days, either change the "Time Flow Rate" to "days" and use the "step time forward" button (▌►) or highlight the date and use the up/down arrows on the keyboard.

How long has it taken from September 30?

Question 2c: (1) Multiply the number you found in **question 1b** by 365. This is the **approximate** number of minutes that rising, meridian crossing, and setting all change in one year. **Show the numbers you used in your calculation and the answer. (for an example with the wrong numbers, you might write 365 x 10 = 3650).**

(2) Next, divide this result by 1440 (the number of minutes in a **day**). Show your calculation as above. This will be the approximate number of days that these times change over the course of a year. It is only approximate because in 1b we ignored seconds and only looked at minutes. **As above, show the calculation.** Round your answer off to the nearest day!

Question 2d: Based on the answer to 2c, what happens to the rising, meridian crossing, and setting times of stars after one year has passed? If there is a shift of exactly one day, how would the times on a clock compare to one year previous?

Question 3: Go to 3: The cause of shifting constellatons. Imagine yourself on the Sun, looking at the Earth and the sky behind it (which a person on the Earth could see at night). Press the "run time forward" button (▶) to advance time by days. Which of the following statements is correct?

☐ **a.** The nighttime side of the Earth always faces the same constellation.
☐ **b.** The Earth does not rotate.
☐ **c.** The nighttime side of the Earth faces different parts of the sky during the year.
☐ **d.** The sky rotates around the Earth.

Question 4: What causes the slow shift of the stars and constellations from one night to the next?

☐ **a.** The changing Earth-Sun distance.
☐ **b.** The stars' motion through space.
☐ **c.** The Earth's daily rotation.
☐ **d.** The Earth's revolution around the Sun once a year.

Exercise A7: Solar and Sidereal Days. The previous exercise addressed the sidereal day, the length of the day as measured by the stars. In this exercise you will see how the length of the day as measured by the Sun is not always 24 hours. Even though the Earth spins at a constant rate, it does not orbit the Sun at a constant rate, as explained by Kepler's second law. The interaction changes the time at which the Sun passes the meridian (solar noon).

Open the **SkyGuide** pane, and navigate to
Student Exercises > A: Earth, Moon and Sun
> A7: Solar and Sidereal Days

Question 1a: Go to 1: Apparent solar day. Follow the instructions in the program. You must **click** at the appropriate location to zoom in on the Sun. After one 24 hour period (known as one "mean solar day"), is the Sun exactly on the meridian, east of it, or west of it? Remember, east is to the left, west is to the right.

Question 1b: Continue with the instructions to get the Sun back on the meridian (either use the "step time forward" button (▌►) set to 1 second increments or click on the seconds in the time readout and use the keyboard arrow keys). (1) Did you move time forward or back? (2) Is the Sun on the meridian before or after noon as measured by the clock?

Question 1c: What is the approximate length of an "apparent solar day" from June 21, 2010 to June 22, 2010 (the time from one meridian crossing to the next) to the second?

Question 2a: Repeat the above steps for questions 2a and 2b. Remember to click at the appropriate place to zoom in on the Sun on September 21! Note that if you use the "step time forward" button for 2b, you must set the “Time Flow Rate” to “days” for 2a and “seconds” for 2b. Alternatively, you can highlight the appropriate number in “Time and Date” and use the keyboard up/down arrow.

After one 24 hour period is the Sun exactly on the meridian, east of it, or west of it?

Question 2b: (1) Did you move time forward or back? (2) Is the Sun on the meridian before or after noon as measured by the clock?

Question 2c: What is the approximate length of an apparent solar day from September 21, 2010 to September 22, 2010 to the second?

Question 3: read the material on 2: Mean solar day. Why do we use mean solar time instead of using true solar time (“mean” means average)?