Name ____

Date________________

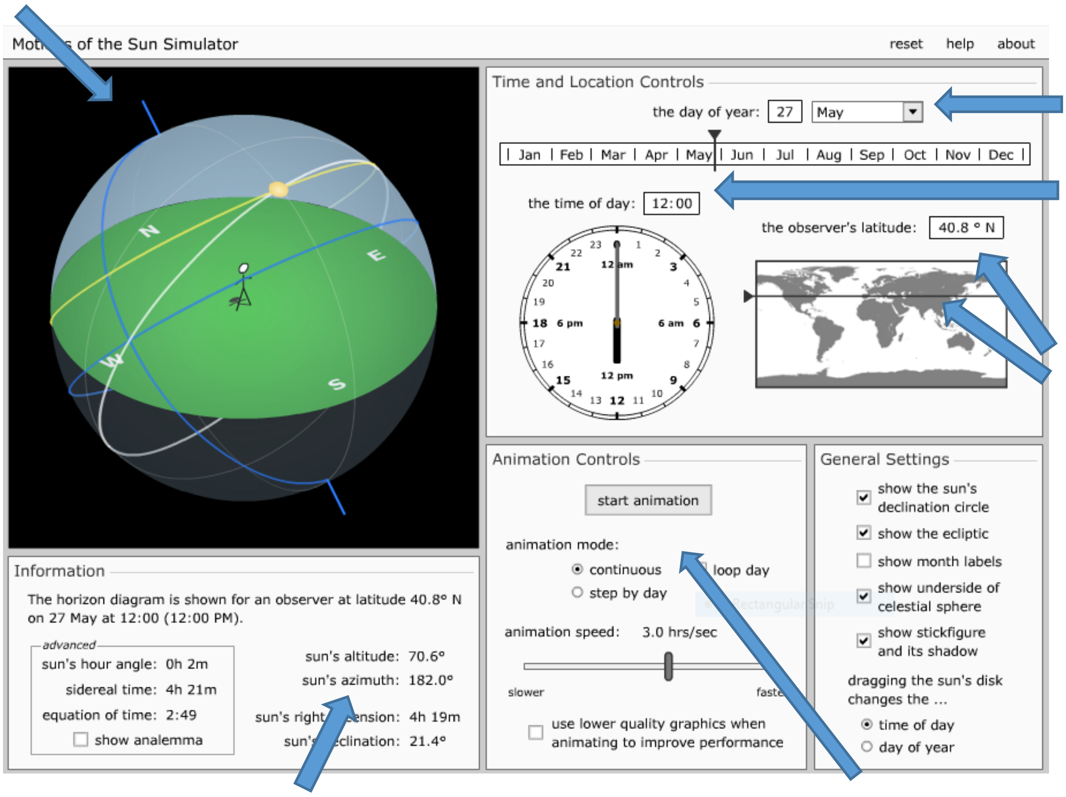
Bell ________________

Motions of the Sun Model Exploration

1. Go to the University of Nebraska-Lincoln Motions of the Sun Simulator: http://astro.unl.edu/naap/motion3/animations/sunmotions.swf

2. This is what you will see. Now I will point out some parts of this page you can manipulate.

You can change the orientation of Earth here. If you click and hold your curse button, you can turn the Earth and position it so that your view is straight on rather than angled.



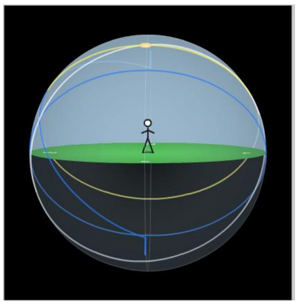
You can change the date or time of day here

You can change the latitude of the stick figure on Earth here (typing in the number or dragging the bar)

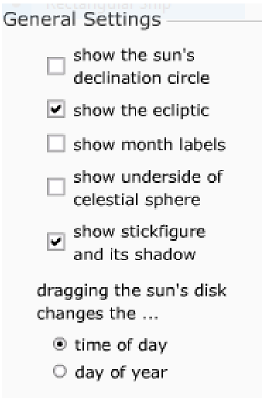
Here is where you can find out the solar elevation angle (the altitude) and the azimuth, as the sun moves across the sky. There's some other number here as well, but those two will be the ones you will be recording

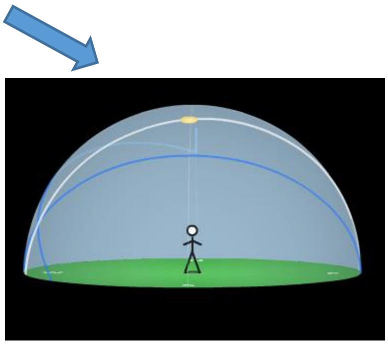
Here is where you start and stop time in the animation. The sun will appear to rise and set continuously in this animation.

3. Let's start exploring by reorienting the Earth to a different view. Using your mouse, click and drag the Earth so that south is towards the top of your screen and the horizon is parallel to the top of your screen. This is what you should see when you are finished.



4. Now unclick the boxes on the bottom right of your screen that say "show the Sun's declination circle" and "show the underside of the celestial sphere."
    a. This is what you should see now





5. change the Latitude to 39.1 N (which is the latitude of Cincinnati, Ohio)
6. Now change the date to June 15th
7. Change the time of day to 6:00 am.

From this point on, you will be answering questions about certain things you will observe. You may need to back up and try again, or manipulate your model to find the answer. This means feel free to play around with the numbers and tools on your screen to find the answers. Good Luck!

Motions of the Sun Exploration

1. A.) In the model, is the sun currently in the Cincinnati Sky at 6 am? ________________

   B.) What evidence from the page did you sue to answer that question?

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2. At what two times is the sun at an altitude of 0? (you can spin the hands of the clock or type in a time to figure this out- BTW, you can also grab the Sin in the model and move it along its path)

   _____________________________ and _________________________

3. Using your times above in question 2, calculate how much daylight we will have during June 15th. Write that answer in the blank below.

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4. Now you are going to record sunrise and sunset times for one year in Cincinnati in the table below. Use the sunrise/sunset chart you are given to find the information you need. Do this step first, then calculate the hours of daylight for each date (elapsed time).

Date	Sunrise Time	Sunset Time	Hours of Daylight (Elapsed Time)
January 15th			
February 15th			
March 15th			
April 15th			
May 15th			
June 15th			
July 15th			
August 15th			
September 15th			
October 15th			
November 15th			
December 15th			

5. A.) Look at your chart in number 4, what do you notice about hours of daylight in winter months versus summer months?

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B.) What do you notice about sunrise and sunset times in winter months versus summer months?

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6. Now using the Motions of the Sun Simulator go back to January 15th and find the Sun's highest altitude for the day. Record that information in the chart below. Repeat for the other dates.

Date	Highest Altitude (Zenith)	Average High Temperature
January 15th		40 degrees Fahrenheit
February 15th		45 degrees Fahrenheit
March 15th		55 degrees Fahrenheit
April 15th		66 degrees Fahrenheit
May 15th		75 degrees Fahrenheit
June 15th		83 degrees Fahrenheit
July 15th		87 degrees Fahrenheit
August 15th		86 degrees Fahrenheit
September 15th		79 degrees Fahrenheit
October 15th		68 degrees Fahrenheit
November 15th		56 degrees Fahrenheit
December 15th		43 degrees Fahrenheit

7. A.) What do you notice about the highest altitude of the Sun in winter months versus summer months?

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   B.) What relationship do you notice between the average high temperature and the highest solar elevation (zenith)?

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8. Now using the Motion of the Sun Simulator, let's explore how the sun moves across the sky differently at different latitudes.
   a. **Change the latitude of the stick figure to 0. Change the time of day to 6:00 am. Change the date to June 15th**. As you can see, the sun is just rising for this person on the ***equator***.
   b. Start the animation by clicking on the "start animation button."
   c. Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
   d. What do you notice about the altitude of the sun? How does that affect the stick figure's shadow midday? What is the path of the Sun? Horizontally or vertically?

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   e. **Change the latitude of the stick figure to 90 N. Change the time of day to 6:00 am. Change the date to June 15th**. As you can see, it's currently daytime at the ***North Pole.***
   f. Start the animation by clicking on the "start animation button."
   g. Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
   h. What do you notice about the altitude of the Sun? How is the path of the sun different at the North Pole different from at the Equator? What about the stick figure's shadow?

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Do you think the Sun's Path will be different in the ***South Pole*** at this time of the year? Let's see!

i. **Change the latitude of the stick figure to 90 S. change the time of day to 6:00 am. Change the date to June 15th.** As you can see, it's currently night time at the ***South Pole.***
j. Start the animation by clicking on the "start animation button."
k. Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
l. What do you notice about the altitude of the Sun? How is the path of the Sun different at the North Pole than the South Pole in June? Why do you think this is? Is it dark or light outside and for how long?

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Now let's explore what each of these paths look like in ***January***. Do you think they will be the same or different? ______________________________

9. What will the Sun's path at the ***equator*** will be like in ***January***?
   a. **Change the latitude of the stick figure to 0. Change the time of day to 6:00 am. Change the date to January 15th. Next set it to June 15th. 6:00 am.**
   b. Start the animation by clicking on the "start animation button." Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
   c. **Compare** the path of the Sun in **January** at the **equator** to the path in **June**. How are these paths similar or different? How are the shadows? Is it dark or light outside? What are the sun's altitudes in January and June?

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What do you think the Sun's path at the ***North Pole*** will be like at this time of year? Let's see!

d. **Change the Latitude of the stick figure to 90 N. Change the time of day to 6:00 am. Change the date to January 15th.**
e. Start the animation by clicking on the "start animation button." Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
f. **Compare** the path of the Sun in **January** at the **North Pole** to the path in **June.** How are these paths similar or different? How are the shadows? Is it dark or light outside? What are the sun's altitudes in January and June?

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What do you think the Sun's path at the ***South Pole*** will be like at this time of year? Let's see!

g. **Change the latitude of the stick figure to 90 S. Change the time of day to 6:00 am. Change the date to January 15th.**
h. Start the animation by clicking on the "start animation button."
i. Watch the sun move across the sky for several days. Watch how the shadow of the stick figure changes throughout the day.
j. **Compare** the path of the sun in **January** at the **South** **Pole** to the path in **June**. How are these paths similar or different? How are the shadows? Is it dark or light outside? What are the sun's altitudes in January and June?

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k. What did you notice about the path of the Sun at the North and South Poles during different times of year? Why do you think they are polar opposites (excuse the puns)?

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l. Have you ever heard the expression "land of the midnight sun?" What do you think that is a reference to? Change the latitude of the stick figure to 90 N, Change the time of day to 00:00 am (midnight), Change the date to June 15th, to find out the answer.

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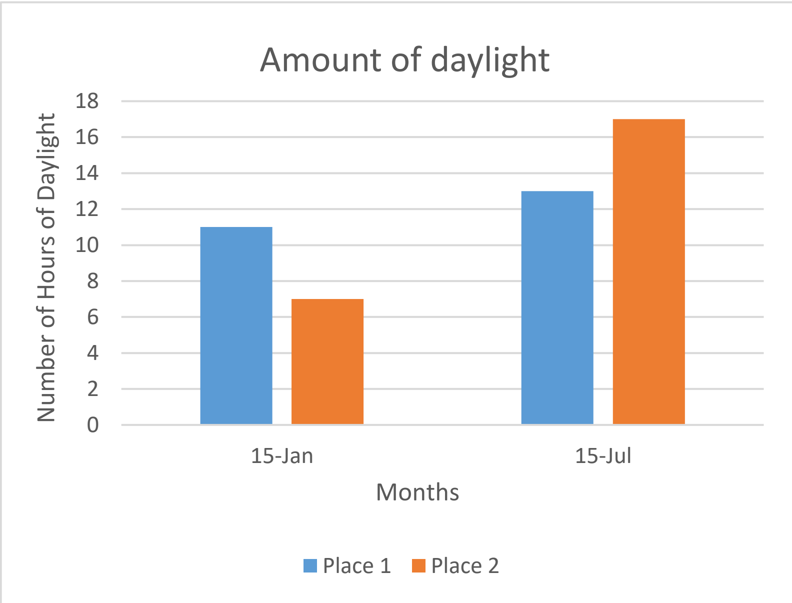
Now answer the following questions. Circle the correct answer.

10. When does the South Pole have a greater number of hours of daylight than anywhere else on earth?
    a. When the South Pole is angled away from the Sun
    b. When the South Pole is angled towards the Sun
    c. When the South Pole is not angled at all towards or away from the Sun
    d. Never
11. For two locations in the Northern Hemisphere during the Northern hemisphere's summer, when will Location A have a longer day than Location B
    a. If location A is on a higher line of latitude than location B
    b. If location A is closer to the equator than location B
    c. One location will never have a longer day than the other because they are both in the same hemisphere
    d. If location A is closer to the prime meridian than location B



12. A student who lives at place 1 measured the number of hours of sunlight on a day in January and on a day in July. Another student, who lives at Place 2 made the same measurement on the same two days. Both places are in the northern hemisphere.

    Based on their measurements, as shown in the graph above, what must be TRUE about place two?

    A. Place 2 is closer to the Equator than Place 1
    B. Place 2 is farther from the Equator than Place 1
    C. Place 2 is father to the east than Place 1
    D. Place 2 could be north, south, or east of place 1, because the number of hours of sunlight cannot be used to compare the location of one place to another.