

Figure 1 illustrates the sky as seen from the continental United States. It shows that the Sun's daily path across the sky (dashed/solid line) is longest on June 21 and shortest on December 21. In addition, on June 21, which is called the summer solstice, the Sun reaches its maximum height in the southern sky above the horizon at about noon. The figure shows that the Sun never actually reaches the zenith for any observer in the continental United States. In other words, the Sun is never directly overhead. Over the six months following the summer solstice, the height of the Sun at noon moves progressively lower and lower until December 21, the winter solstice. Thus, we see that the path of the Sun through the southern sky changes considerably over the course of a year.

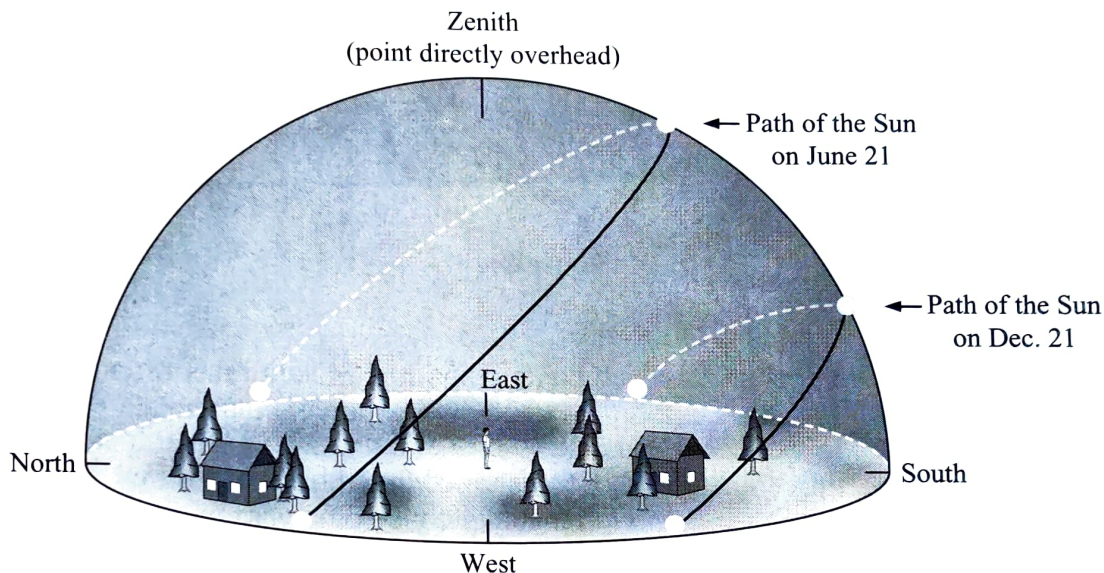


Figure 1

1) According to Figure 1, in which direction would you look to see the Sun when it reaches its highest position in the sky today?

Circle one: east southeast south southwest west

2) If it is wintertime right now (just after the winter solstice), how does the height of the Sun at noon change over the next several months?

Circle one: increases stays the same decreases

3) Since Figure 1 is a reasonable representation for observers in the continental United States, is there ever a time of year when the Sun is directly overhead at the zenith (looking straight up) at noon? If so, on what date does this occur?

4) During what time(s) of year would the Sun rise:

- a) north of east?
- b) south of east?
- c) directly in the east?

- 5) Does the Sun always set in precisely the same location throughout the year? If not, describe in what way the direction of where the Sun sets changes throughout the year.

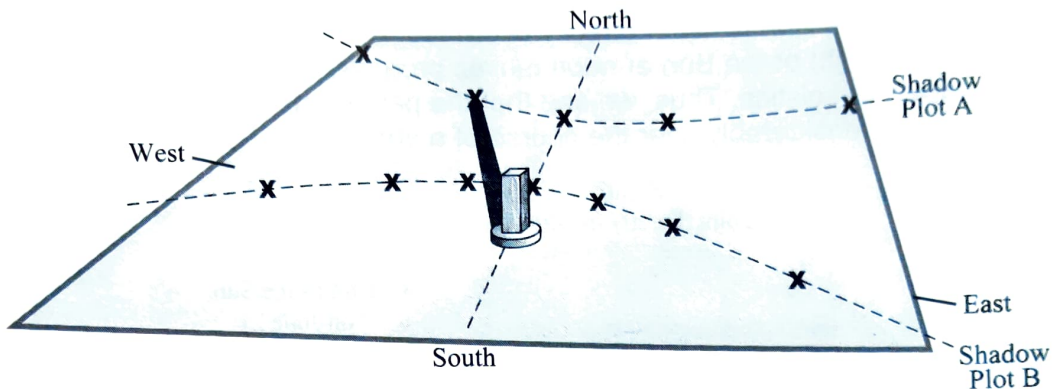


Figure 2

Figure 2 shows a small, vertical stick, which casts a shadow while it rests on a large piece of paper or poster board. You can think of this to be somewhat like a sundial.

For two different days of the year, the end of the shadow has been marked with an **x** every couple of hours throughout the day. Although this sketch is somewhat exaggerated, these *shadow plots* indicate how the position of the Sun changes in the sky through the course of these two days. The following questions are designed to show the relationship between Figure 1 on the previous page and Figure 2 above.

- 6) What do the **x**'s in the shadow plots represent?
- 7) Approximately how much time went by from the time one of the **x**'s was drawn until the next **x** was drawn for each shadow plot?
- 8) Approximately how long did it take to create each of the shadow plots?
- 9) How does the direction of the stick's shadow compare to the location of the Sun at the time each **x** was drawn?
- 10) Using Figures 1 and 2, in what direction would the shadow of the stick be cast on the poster board if the Sun rises in the southeast?
- Circle one:** west northwest north northeast east southeast
- 11) Clearly circle the **x** for the shadow that corresponds to noon for Shadow Plot A and for Shadow Plot B.

- 12) Compare the position of the x that corresponds to noon for Shadow Plots A and B. Which Shadow Plot (A or B) corresponds to a path of the Sun in which the Sun is highest in the sky at noon? Explain your reasoning.
- 13) Which Shadow Plot (A or B) most closely corresponds to the Sun's path through the sky during the summer, and which corresponds with the winter? Label these paths on Figure 2. Explain your reasoning.
- 14) On Figure 2, sketch the Sun's position shortly after sunrise in the summer and label the x that indicates the position of the end of the stick's shadow at this time. Explain your reasoning for why you sketched the Sun where you did and labeled the x that you did.
- 15) Based on the shadow plots in Figure 2, during which time of the year (summer or winter) does the Sun rise to the south of east? Explain your reasoning.
- 16) If Shadow Plot A corresponds to the path of the Sun on the day of the winter solstice, is it possible that there would ever be a time when the stick would cast a shadow longer than the one shown along the north-to-south line that indicates the Sun's position at noon? Explain your reasoning.

- 17) If Shadow Plot B corresponds to the path of the Sun on the day of the summer solstice, is it possible that there would ever be a time when the stick would cast a shadow shorter than the one shown along the north-to-south line that indicates the Sun's position at noon? Explain your reasoning.
- 18) If you were to mark the end of the stick's shadow with an **x**, where would the **x** be placed along the north-to-south line to indicate the Sun's position at noon *today*? Clearly explain why you placed the **x** where you did.
- 19) Will the stick ever cast a shadow along the north-to-south line that extends to the south of the stick at noon? Explain your reasoning.
- 20) Is there ever a clear (no clouds) day of the year in the continental United States when the stick casts no shadow? If so, when does this occur, and where exactly in the sky does the Sun have to be?