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The Human Sundial

Activity Instructions

This document contains complete instructions for two methods of constructing a sundial. The first method (**Figure 1**) is a group activity in which students construct a sundial outline indoors and then obtain the time markings by placing it outside and marking hourly observations. The second method (**Figure 2**) requires students to plan, measure and mark the 'time angles' of an ellipse then lay their design outside and test it hourly to determine its accuracy.

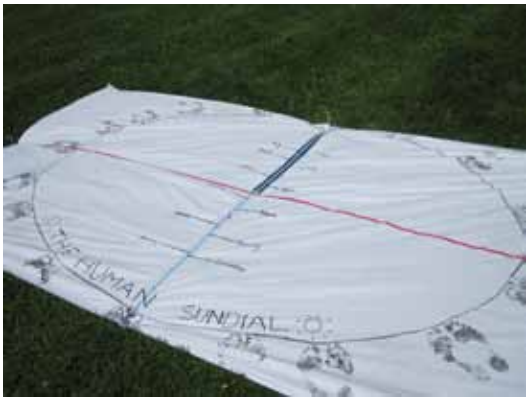

Figure 1

Figure 2

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The Human Sundial - Activity Instructions

Method One

Part I - Drawing the Ellipse

The following items will be needed for this method:

- shower curtains
- duct tape
- trail marking tape
- permanent marker
- measuring tape
- string

Step 1

Lay out the shower curtains side by side and tape them together. Use coloured tape to divide the sheet into four quadrants. These lines will be the axes. Label the longer one as the x-axis and the shorter one as the y-axis. Using a permanent marker, mark and label 10 cm intervals along the axis. Imagine the sheet has become a giant piece of graph paper with Cartesian axes.

Step 2

Take the length of string and mark two lengths, a and b, as shown in **figure 3**.

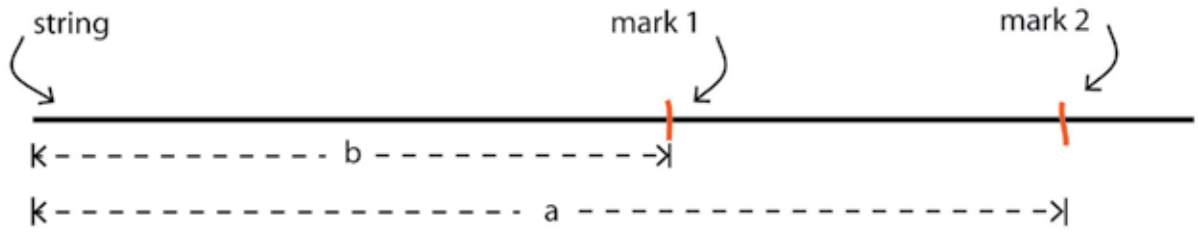

Figure 3

Step 3

Select one student to stand on the origin and hold one end of the string.

Step 4

The other students should form pairs. One student from each pair will be the first data point. These students should now take turns extending the string radially outwards from the origin and standing on the string with the tip of their shoes. The students should be forming a circle of diameter b **(Figure 4).** Make sure the string is only extended to length b.

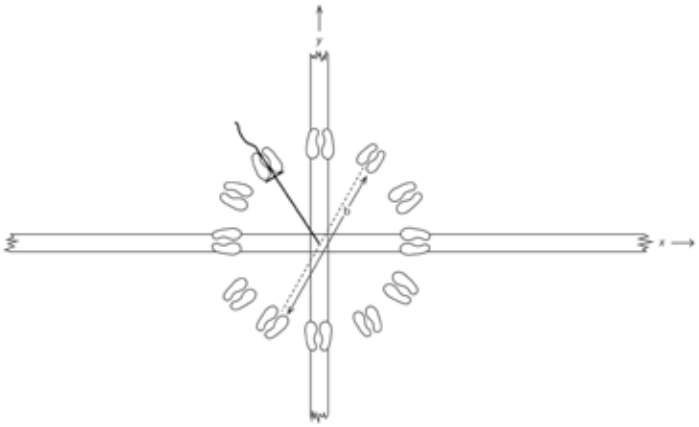

Figure 4

Step 5

Students should identify their position as a point on the grid. Have their partners record the x and y coordinates of their position.

Step 6

The second student from each pair will now become the next data point. As it is important to maintain the same angle for each data point, the first student in each pair should remain standing on the string at mark 1 while the second student stands on the string at mark 2, ensuring the string forms a straight line (**Figure 5**). Repeat for each pair.

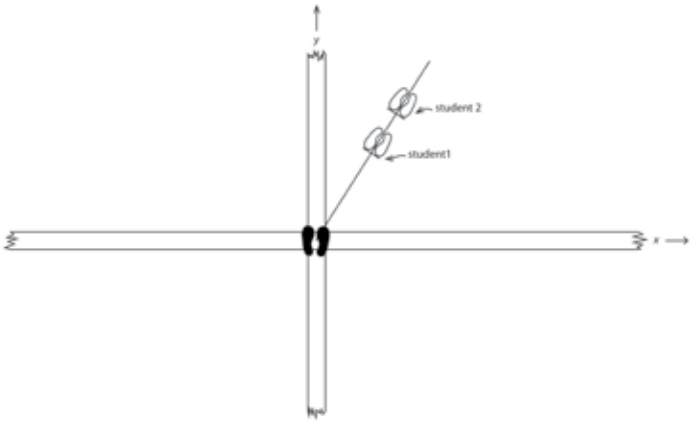

Figure 5

Step 7

The students of the outer circle should identify the coordinates of their position. The first students can leave their positions to record this.

Step 8

One student from each pair should stand on this new point. The students should be forming an ellipse. The second student should mark their partners' position with electrical tape. Using the marker, try to fill in the rest of the ellipse, as shown in **figure 6**.

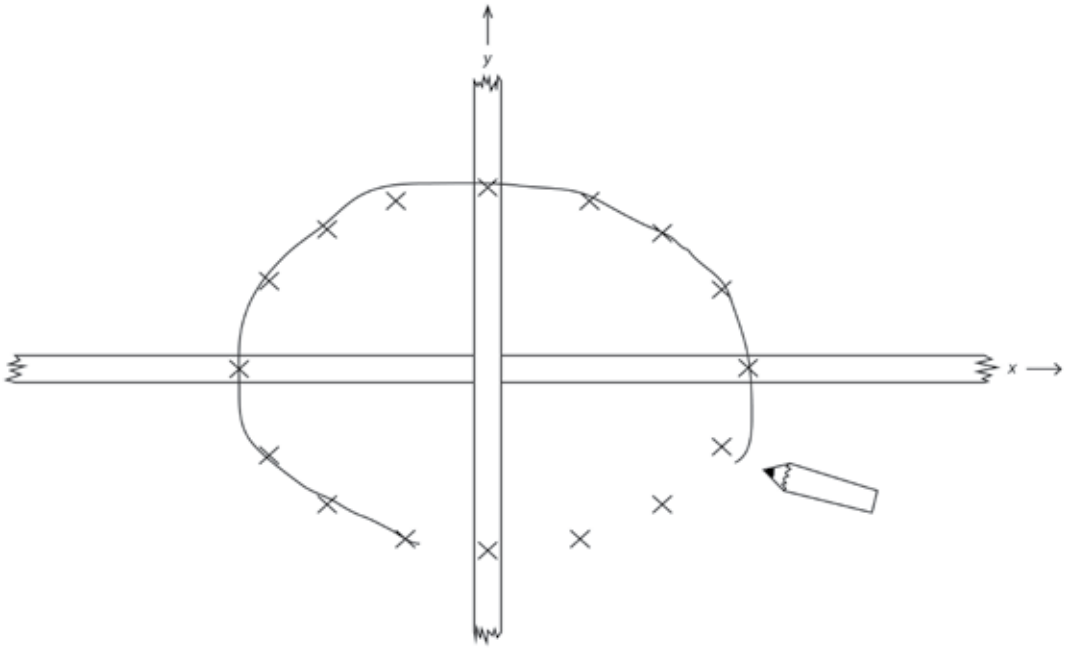

Figure 6

Step 9

The sundial must be adjusted for the time of year by standing in the correct position along the y-axis. This is determined by the lengths calculated in the *Prep Instructions*. Instruct students to mark these lengths along the y-axis, measuring the distance from the origin. Positive values indicate North, negative values indicate South. Write the name of the month next to each mark.

Part II - Marking the Time

Now that the sundial is laid out, the students must mark their positions each hour. This is best done as close to the first of each month as possible. The following items will be needed:

- permanent marker
- compass

Step 1

Select one student to be the gnomon. It is best if the same person is used throughout the experiment. As a class, decide how the time will be marked. For example, a straight line through the middle of the shadow, the outline of the shadow or a square around the shadow. This method should remain consistent.

Step 2

Take the sundial outside and select a sunny area. Align the y-axis along the line of true north line using a compass and the angle of declination calculated in the *Prep Instructions*.

Step 3

Choose a day where the forecast calls for sun for the entire day. Beginning as early in the day as possible, have the gnomon stand on the appropriate date line at each hour. Mark the time as determined in Step 1. Write the hour by each mark.

Step 4

The sundial is complete. Test the sundial at various time throughout the year, standing on the appropriate date line.

Method Two

The following items will be needed for this method:

- trail marking tape
- skewers
- chalk
- compass
- measuring tape
- string
- angle sheet (*Appendix I)*

This sundial must be laid out in a location that receives full sun throughout the day and will not be disturbed. If a grassy area is available, use skewers for the markers and coloured tape for the axes. If only a paved surface can be located, use chalk to mark the axes and squares of electrical tape as markers.

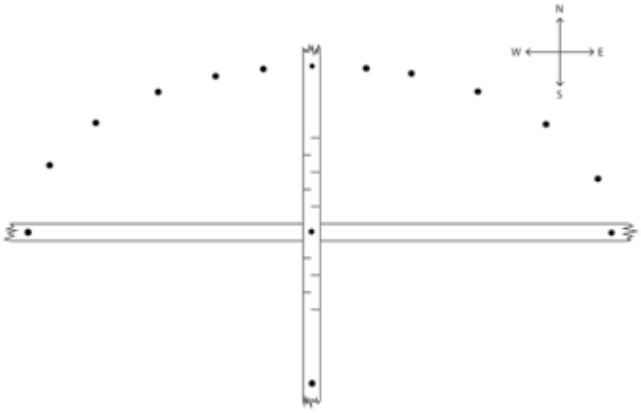

Figure 7

Step 1

Using the trail marking tape, skewers and a compass, mark out the x-axis (3 m) and y-axis (2 m) as shown in **figure 7**. Ensure that it is oriented towards true north, as calculated in the *Prep Instructions*.

Step 2

Print out the angle sheet provided in *Appendix I*. Skewer it to the origin and line it up with the x-axis as in **figure 8**. Ensure it is on the northern side of the x-axis.

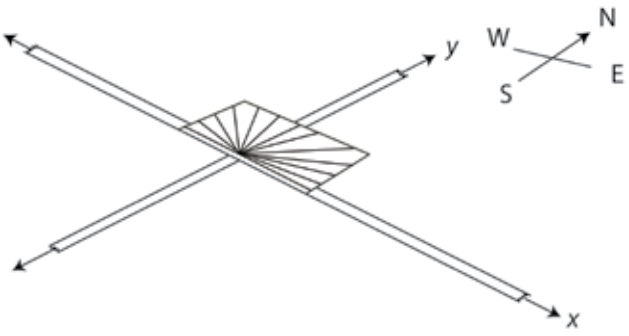

Figure 8

Step 3

Take the length of string and mark two lengths, a and b, as shown in **figure 9**.

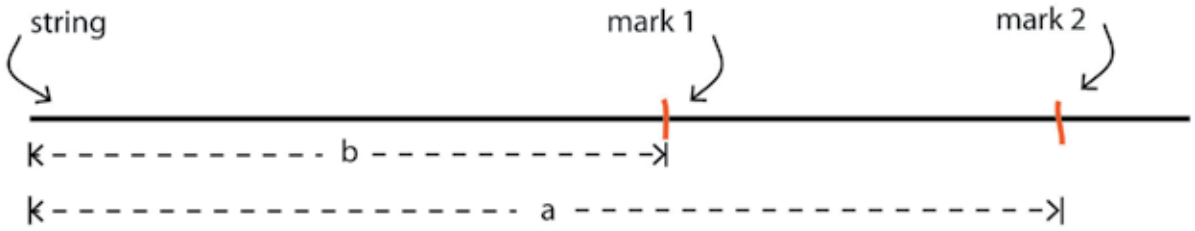

Figure 9

Step 4

Attach the string to the skewer at the origin.

Step 5

Extend the string radially outwards, lining it up with the first line on the angle sheet. At mark 1, lay a skewer parallel to the x-axis. At mark 2, lay a skewer parallel to the y-axis **(Figure 10**).

Step 6

Insert a skewer into the grass at the intersection of the two lines, as shown in **figure 10**. Repeat for all lines on the angle sheet. Note that on each axis, the skewer marker will be at either mark 1 or 2 on the string.

Step 7

The skewers now mark out the hourly coordinates of the ellipse. However, the sundial must be adjusted for the time of year by standing in the correct position along the y-axis. This is determined by the lengths calculated in the *Prep Instructions*. Mark these lengths along the y-axis with tape, measuring the distance from the origin. Positive values indicate north and negative values indicate south. Write the name of the month on each piece of tape. The sundial is now ready to use. Test the accuracy by having a student stand in the centre at different times.

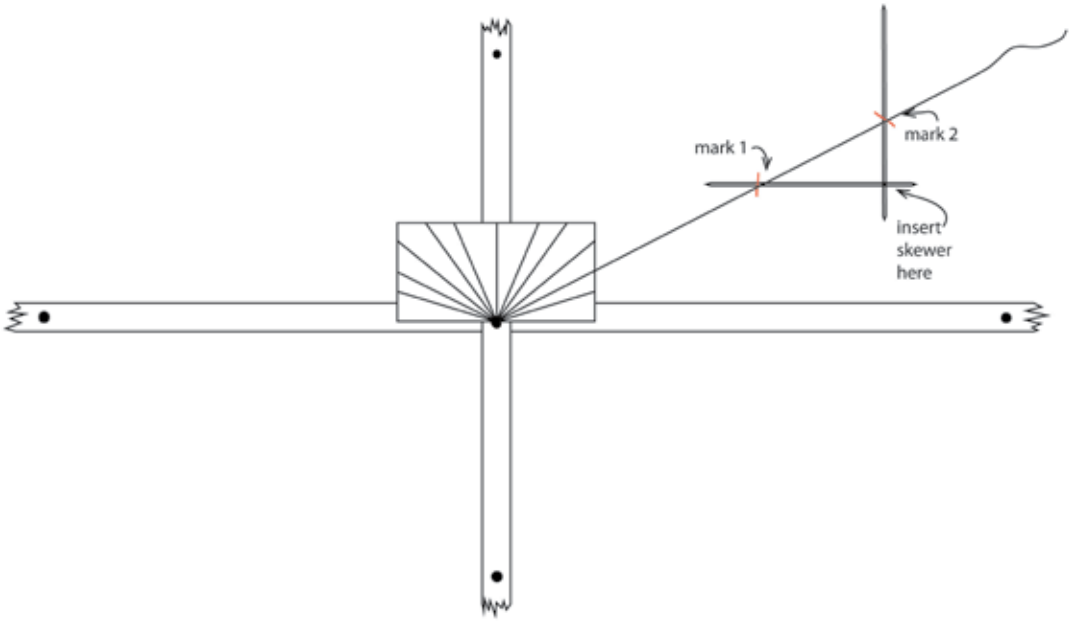

Figure 10

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Appendix I

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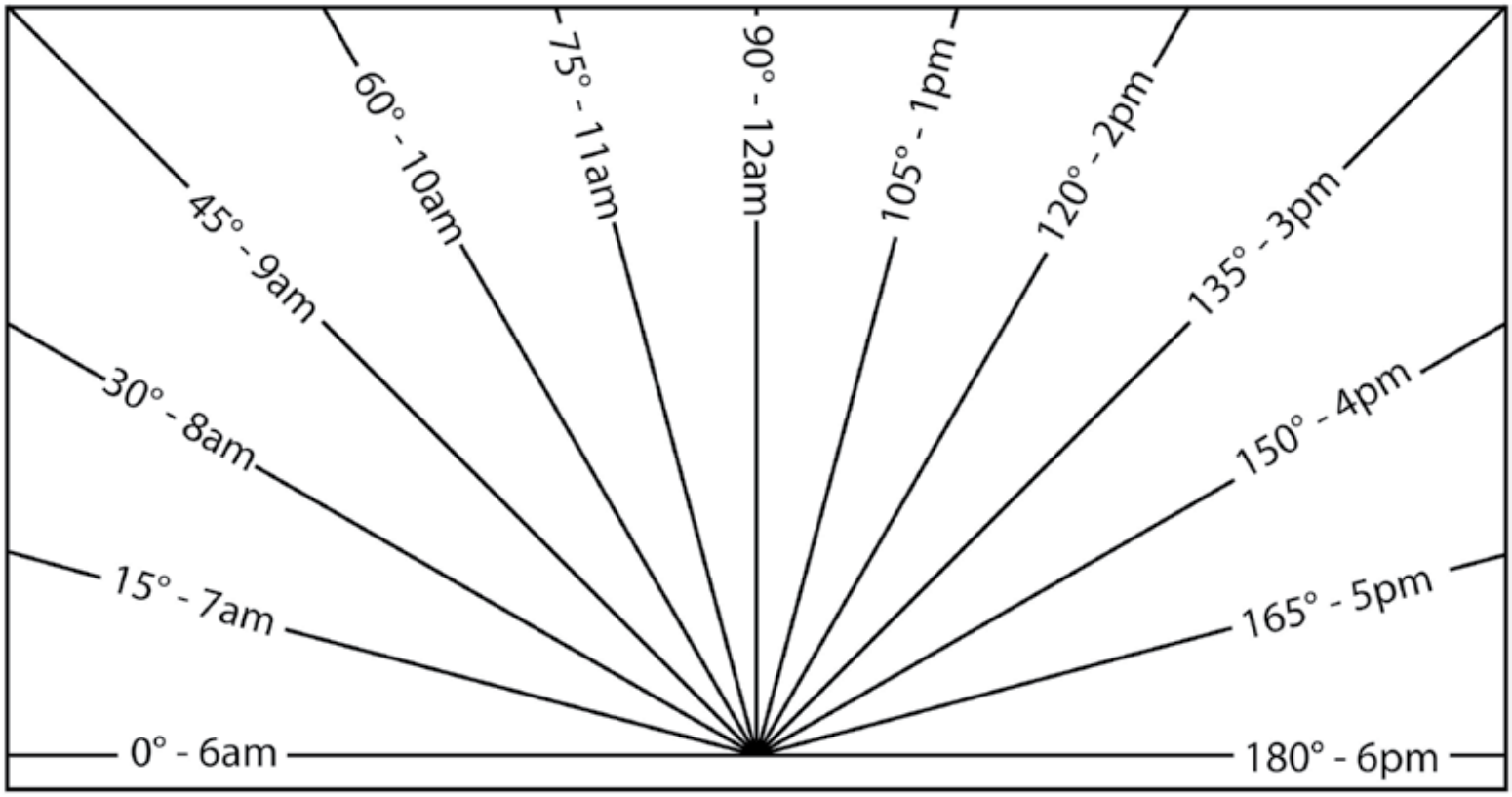

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