The Astronomer: STEM-based Classroom Lesson

In order to properly observe celestial objects like comets and stars, astronomers have to be able to measure their position in the sky. Since the sky covers an area of 180 degrees (half of a 360 degree circle), the altitude or height of an object can be measured in degrees above the horizon.

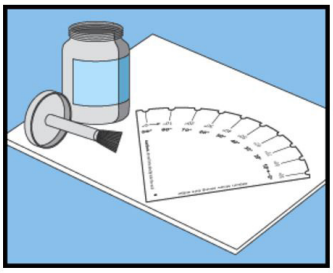
The instrument that astronomers, navigators, and scientists like Kino used was called an astrolabe (pronounced AS-tro-layb). Padre Kino made his own astrolabes and sold them to raise funds for his journey. Now you will, too! (Lesson courtesy of http://cse.ssl.berkeley.edu/AtHomeAstronomy/activity_07.html)

Make Your Own Astrolabe

Materials:

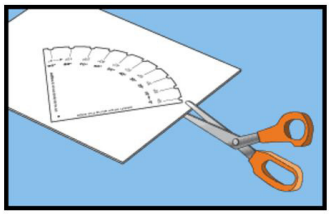
astrolabe drawing (page 2)
piece of cardboard, cereal box, manila file folder, or other stiff paper
piece of dark yarn or string 12 inches (30 centimeters) long.
small weight, such as a metal washer or nut
plastic drinking straw
glue or paste
pair of scissors
roll of tape
single hole puncher

1.) Glue the astrolabe drawing to a piece of cardboard, cereal box, or file folder.

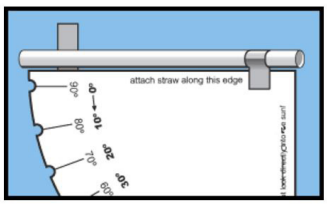


2.) Cut out the shape with scissors.

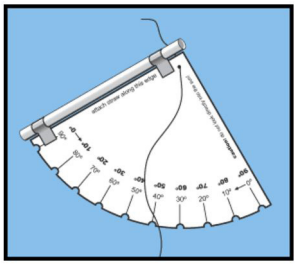
3.) Using scissors or a hole-puncher, carefully make a small notch at each of the lines marked along the curved edge of the astrolabe.



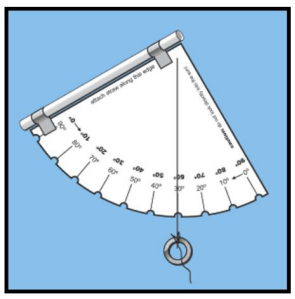
4.) Cut a drinking straw to the same length as the sides of the astrolabe. Tape the drinking straw to the edge of the astrolabe marked "Attach straw to this edge." Be careful to not tape the straw *on* the astrolabe, but just on the edge.



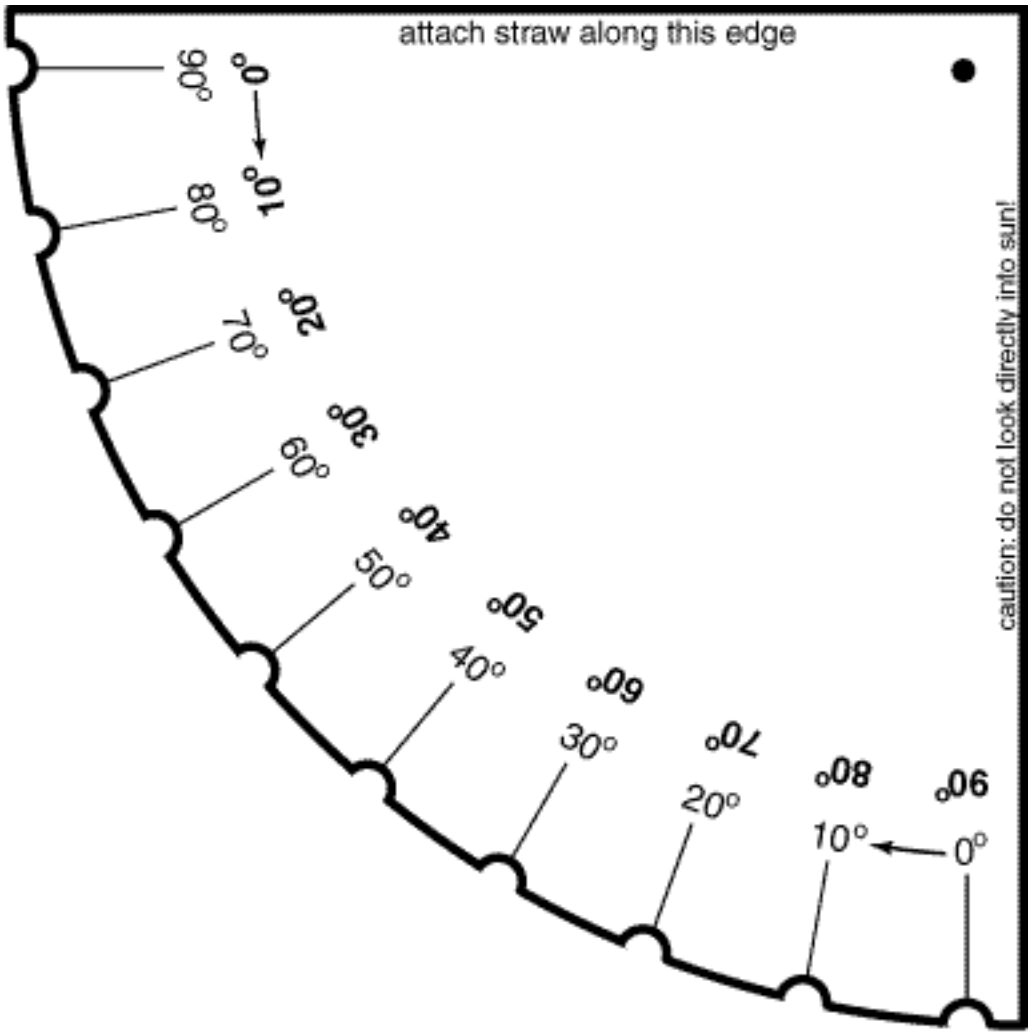
5.) Carefully poke a small hole through the astrolabe where the "X" is marked, pass the string through it, and either knot the string at the back of the cardboard or tape it there.



5. Tie the small weight to the opposite (front) end of the string as shown.

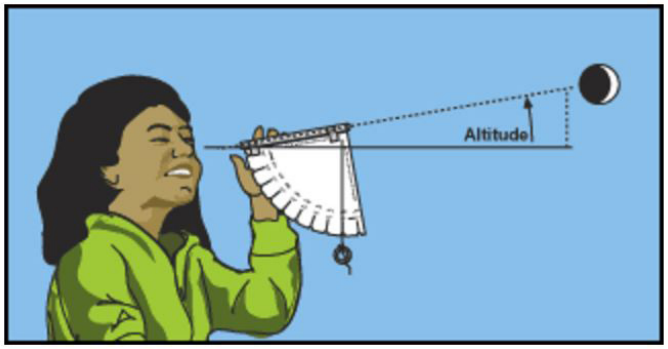


Congratulations! You've made your first astronomical instrument.


attach straw along this edge
caution: do not look directly into sun!
90°
80°
70°
60°
50°
40°
30°
20°
10°
0°
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°

An astrolabe can be used to measure the altitude of an object, including changes in the sun's path over the course of the year. Tracking these changes can help explain why days are longer in the summer and shorter in the winter.

Experiment 1 - Measuring the Altitude of Trees and Buildings



To become familiar with how an astrolabe works, practice measuring the altitude (angular height) of trees or buildings. To make a proper measurement, look at the top of the object through the straw.

Have a teammate read the altitude in degrees from the side of the astrolabe. The point where the string crosses the scale is the proper measurement.

	Object #1	Object #2	Object #3
Description			
Altitude (in degrees)			

Experiment 2 - Measuring the Altitude of the Sun

REPEAT AFTER ME: Never look directly at the sun.

Step 1: Aim the straw so that you see the shadow of the straw on your hand. Move the straw slightly until a small circle of light forms on your hand. The straw is now pointing directly at the sun. Again, **never look directly at the sun.**

Step 2: While holding the astrolabe steady, ask a teammate to read the sun's altitude (in degrees) where the string crosses the scale.

Step 3: Record these measurements at the same time each day. Fill in your chart on page 4 with the date, time, and measurements.

As the weeks progress, look at your measurements of the sun's altitude. Can you detect a change? Is the altitude increasing or decreasing? Is there a pattern of change? How can you explain these changes?

In the spring, the altitude of the sun increases. In the fall, you should notice a decrease. The cause of the change in altitude is the tilt of the earth's axis. Where the earth is located in its orbit around the sun will determine both the altitude of the sun at any given point in time and the length of the day. Since the earth's location around the sun is changing continuously, so is the sun's position in the sky.

Tumacácori National Historical Park - Padre Kino's Quest

WEEK 1		Monday	Tuesday	Wednesday	Thursday	Friday
Date						
Time						
Altitude of the sun (in degrees)	1					
	2					
	3					
	Mean or average					

WEEK 2		Monday	Tuesday	Wednesday	Thursday	Friday
Date						
Time						
Altitude of the sun (in degrees)	1					
	2					
	3					
	Mean or average					

WEEK 3		Monday	Tuesday	Wednesday	Thursday	Friday
Date						
Time						
Altitude of the sun (in degrees)	1					
	2					
	3					
	Mean or average					