Equatorial Sundial

Construction: 15 minutes. Activity: Spread over the course of several hours.

Sundials were one of astronomers' first tools to measure the flow of time. This instrument is simply a stick that casts a shadow on a face marked with units of time. As Earth spins, the stick's shadow sweeps along the face. Civilizations around the world, from Anazazi, Babylonian, to Chinese, constructed a variety of similar mechanisms.

Activity

This sundial allows you to read the solar time of day. The face of the sundial is the plane of Earth's equator, whereas the stick represents Earth's axis pointing to the North Celestial Pole.

Preparation

First, find your latitude and longitude and an outdoor observing site in a clear (no shadows) area. Determine the direction north (from a map, or by finding the north star at night and marking its location). Assemble the equipment as described below. Use lamps to demonstrate how to position and read the sundial indoors before going out.

Experiment

On a sunny day, take the sundial outside and direct the pointed end toward north. Record the time on the sundial at least four times in one day. Each time, also record the "clock" time for your date and location. Try this experiment during different months of the year.

Analysis

1. For your data, when is the stick's shadow shortest? Can you predict what time of day it would be the shortest? Can you predict the times of sunrise/sunset from your data? (Confirm with your local newspaper.)
2. If the sundial time did not match clock time, explain why.
3. Why does this sundial have front and back dial faces?

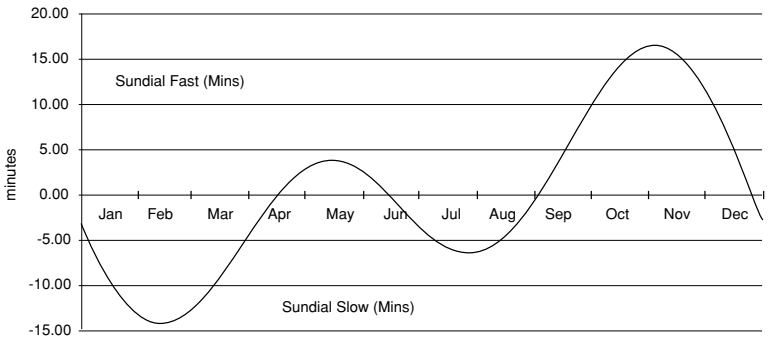
Answers

1. The shadow is shortest at local noon.
2. For each 1 degree east or west of the center of your time zone (your longitude difference from the center), there is a correction of 4 minutes of time. Also, the Sun's orbit in the sky changes with the seasons, and a correction of up to about 15 minutes for the "Equation of Time" must be made. Read the correction from the graph below. Daylight Savings Time changes results by one hour.
3. The north face is for use from March 21 to September 21, and the south face is for use from September 21 to March 21. The Sun is north of the celestial equator during the first period (spring and summer) and south of the celestial equator during the second (fall and winter).

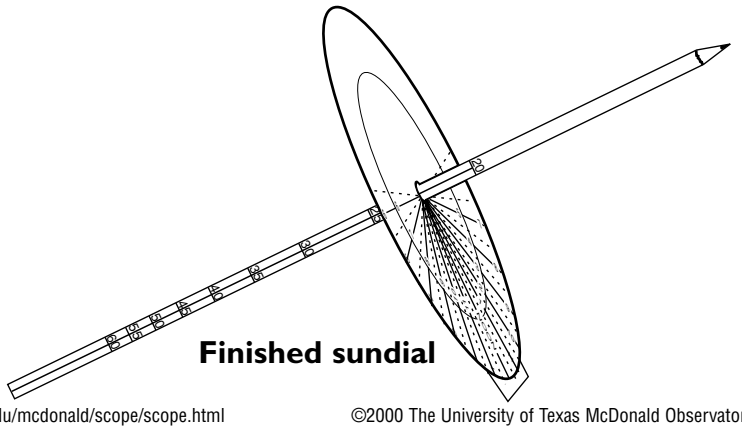
National Science Education Standards:
Earth and Space Science (5-8): The sundial helps tie together concepts of the Earth and Sun system; Earth's rotation and orbit.

Materials and Construction

1. Photocopy the template and one latitude strip.
2. Attach the latitude strip to a stick, such as a 7-inch (18-cm) pencil or straw. Thinner sticks cast thinner shadows.
3. Fold and glue the template. Make sure the dial faces are lined up.
4. Cut out the center hole.
5. Place the stick in the hole with the top face lined up with your latitude. The stick should fit snugly. Make sure the stick and face are perpendicular. Tape it in place if necessary. The bottom end goes on the ground.



Correction for the "Equation of Time"



Finished sundial