Equatorial Sundial

National Science Education Standards

- Content Standard in 5-8 Earth and Space Science (Earth in the solar system)
- Content Standard in 5-8 Science as Inquiry (Abilities necessary to do scientific inquiry)

Egyptian Stonehenge

Summer arrives in the northern hemisphere today, as the Sun appears farthest north for the entire year.

In centuries long past, skywatchers around the world watched for the solstice at special observatories — circles of stones. The most famous is Stonehenge in England, but circles of much smaller stones were found in the Americas, too.

The oldest of these stone observatories may have been built in southern Egypt, at a site called Nabta. It was used 6,000 years ago, and perhaps even earlier — at least a thousand years before Stonehenge.

Anthropologist Fred Wendorf of Southern Methodist University discovered the site in 1973. Last year, studies by Wendorf and Colorado astronomer J. McKim Malville confirmed that Nabta had an astronomical function.

Among other artifacts, the site contains a 12-foot-wide "calendar circle" of small stones. Two pairs of stones stand across the circle from each other. If you look through the spaces between each pair, you'll see the point where the Sun rose on the summer solstice thousands of years ago. This alignment was important to the people who lived at Nabta because monsoons brought a few inches of rain to the region soon after the solstice.

Over the centuries, though, the rains dried up and Nabta was abandoned. But the people of Nabta may have left a legacy. Their culture may have stimulated the formation of Egypt's Old Kingdom — the civilization that built the great pyramids.

One of astronomy's first tools to measure the flow of time, a sundial is simply a stick that casts a shadow on a face marked with units of time. As Earth spins, the stick's shadow sweeps across the face. The face of the sundial represents the plane of Earth's equator, and the stick represents Earth's spin axis.

Preparation

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

Materials and Construction

- Photocopy the template and one latitude strip for each student team.
- Mark a drinking straw using the latitude strip as a guide. First mark the bottom of the scale at one end, then mark each of the latitudes.
- Fold and glue the template. Make sure the dial faces are lined up.
- Cut out the center hole.
- Place the straw in the hole with the top face lined up with your latitude. The straw should fit snugly. Make sure the stick and face are perpendicular. Tape it in place if necessary. The bottom end goes on the ground.

Experiment

On a sunny day, take the sundial outside and aim the pointed end 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.

Analysis

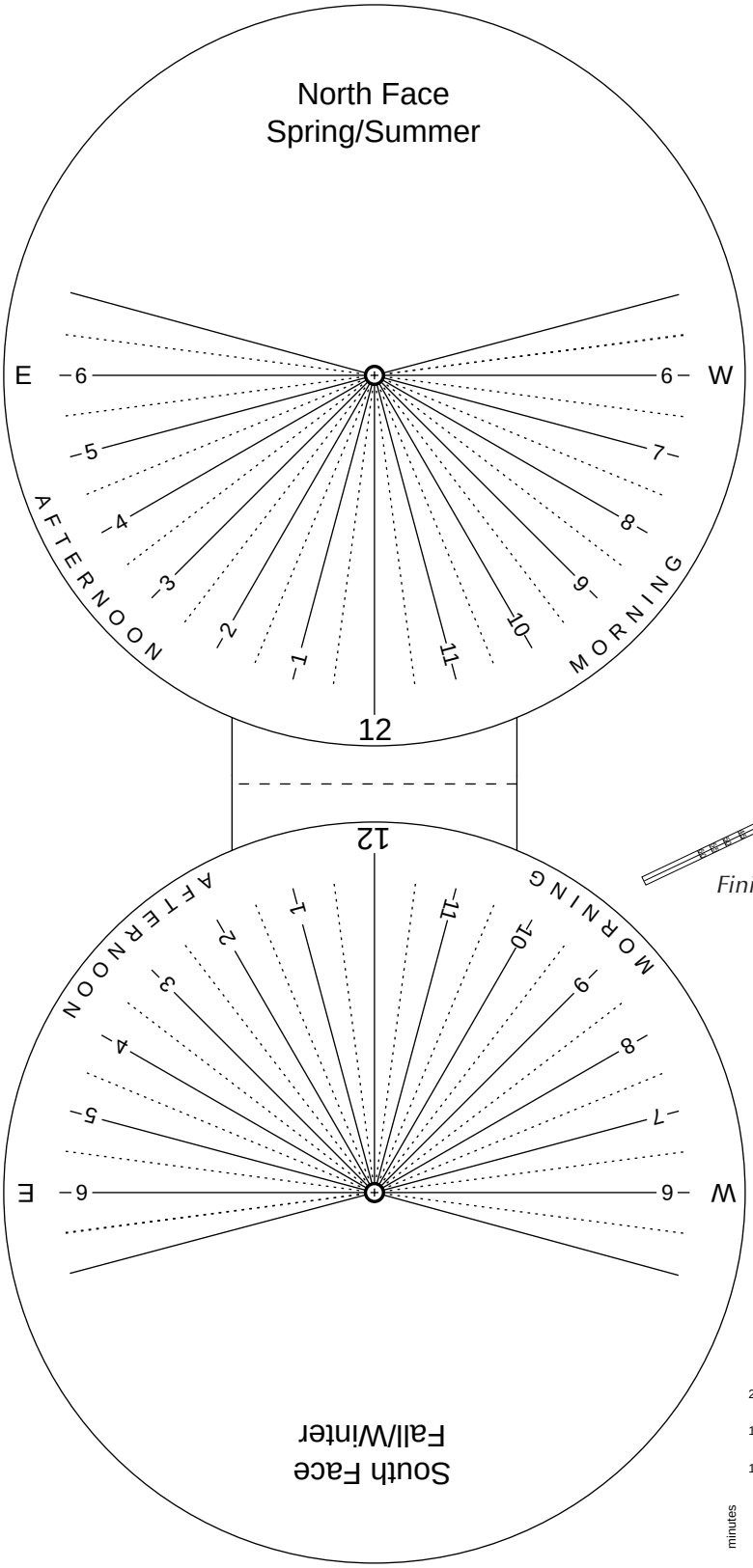
1. When is the stick's shadow shortest? Can you predict what time of day it would be the shortest? Can you predict the times of sunrise/sunset from your data? (Confirm with your local newspaper or the sunrise/sunset calculators on StarDate Online.)
2. If the sundial time did not match clock time, explain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

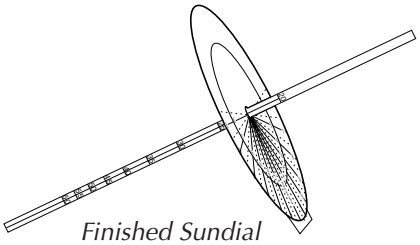
Answers

1. The shadow is shortest at local noon.
2. For each degree east or west of the center of your time zone (your longitude difference from the center), there is a correction of four minutes of time. Also, the Sun's location 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 on page 19. Daylight Savings Time changes results by one hour.
3. The north face is for use from about March 21 to September 21, and the south face is for use from about 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).

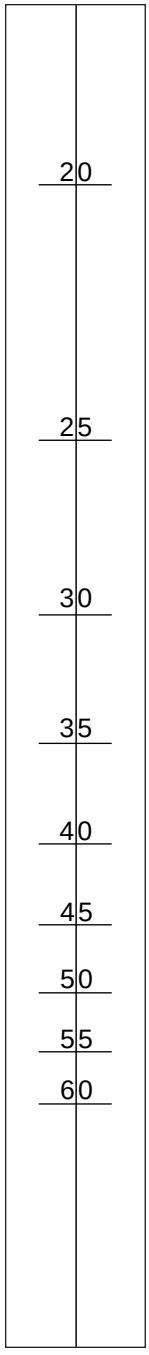
Dial Face Template

Latitude Strip

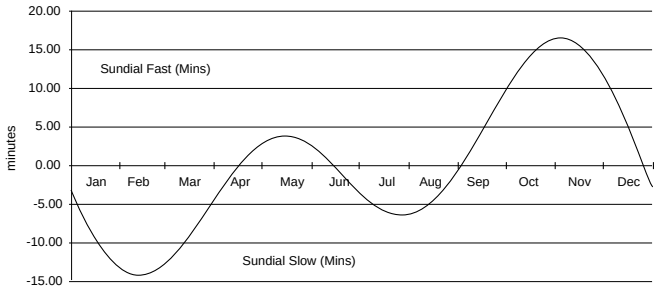




Finished Sundial



Bottom



Correction for the "Equation of Time"