ASTRONOMY

Astronomy 1 Making a Sundial

Before there were mechanical clocks, people used the Sun to tell time. As Earth rotates about its axis, the Sun appears to be moving through the sky, changing its position—even though it is really we who are spinning. Sundials use the change in the Sun's position to measure time. In the morning, your shadow points long into the west as the sun rises in the east. As noon approaches, your shadow gets shorter. Then your shadow points eastward, increasing again, as the Sun sets. The length of your shadow also depends on your **longitude** (distance east or west of the prime meridian, measured by imaginary lines running from the North Pole to the South Pole). In northern winters, the Sun is low in the southern sky and casts a long shadow through most of the day. This results from the tilt in Earth's axis, which gives us seasons.

Earth's axis is tilted 23 degrees. **Precession** is the wobbling of Earth's axis over tens of thousands of years. The **eccentricity** of Earth's orbit is its deviation from a perfect circle. (For more on eccentricity, see chapter 4, "Demonstrating Orbits.")

Materials

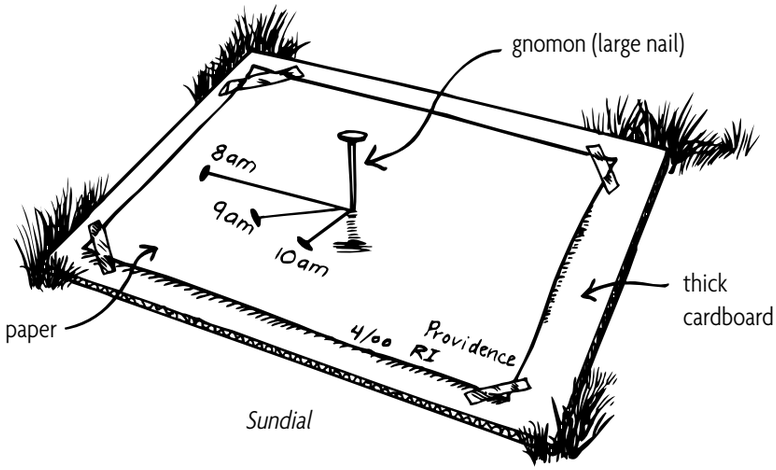
- tape
- sheet of large paper
- 3-to-4-mm-thick sheet of corrugated cardboard or plywood
- hammer
- long nail
- watch
- marker
- ruler

Procedure

1. Find a sunny location on a clear day. Begin early in the morning.
2. Tape a sheet of paper to the cardboard.
3. Hammer a nail into the center of the paper, just far enough in so that it stands firmly on its own.

The part of a sundial that casts a shadow is called a **gnomon.**

4. Mark the shadow of the nail at 1-hour intervals (e.g., 8:00 A.M., 9:00 A.M., etc.). Mark the shadow of the head of the nail, then draw the shadow of the nail using a straightedge or ruler. Mark the time of day. *It is very important that you do not change the position of your board during the day.*
5. At the end of the day, you will have a functional sundial! Record the date and location (city, state) on your sundial.



Sundial

Your sundial is **calibrated** to work in your particular longitude. The farther you travel from where you made your sundial, the less accurate it will be.

6. You can use your paper as a template to make a sundial out of more durable and attractive materials, such as wood, plastic, metal, and so on.

You have constructed a horizontal-dial sundial. There are other types of sundials—for instance, vertical ones. To make a vertical sundial, mount your paper on an upright board that is perpendicular to the ground, and facing south if you live in the Northern Hemisphere.

7. If you move your sundial, recalibrate it by positioning it to read the proper time. You'll have to recalibrate it twice a year anyway if your region goes on and off of daylight saving time.

8. As an extension to this activity, you can make sundials at different times during the year and compare them. The position of the Sun in the sky and hence the shadow changes with the rotation and revolution of Earth.

At the ancient monument Chichén Itzá on Mexico's Yucatán Peninsula, a shadowy snake climbs up the steps during the **vernal equinox** (the time in late March each year when the Sun crosses the equator and day and night are equal in length everywhere). The ancient Mayan designers used mathematics and their understanding of astronomy to engineer a structure that would give this effect.

References

Sundials: Their Theory and Construction by Albert Edmund Waugh (Mineola, N.Y.: Dover, 1973).

Making a Clock-Accurate Sundial Customized to Your Location (for the Northern Hemisphere) by Sam Muller (Happy Camp, Calif.: Naturegraph, 1997).

Scientific American exhibit—Mars Sundial: www.sciam.com/exhibit/1999/042699 sundial/index.html

Sundials on the Internet: www.sundials.co.uk/