Make Your Own Sundial

Brief Summary

Visitors construct their own sundial using pre-printed templates. They then calibrate their sundial using a large-scale calibration machine that simulates the Sun’s motion across the sky.

Equipment Required

- Sundial Calibrator
- Stacks of the two sundial templates
- “Different Types of Time” charts
- Wastepaper basket(s)

Activity Table-Cart including:
- Box of scissors
- Box of crayons or markers
- Box of rulers
- Rolls of Scotch Tape
- Stools

Main Teaching Points

- Daily motion of the Sun across the sky
- How sundials work
- Yearly motions of the Sun

Educational Strategy

On the surface it seems that this activity is about how sundials work. However, in order to understand how sundials work you need to understand how the Sun moves across the sky. Visitors come away with an understanding of the Sun’s motions through the act of making their own sundial.
This activity also has an arts and crafts nature that allows visitors to utilize their kinesthetic and aesthetic intelligences.

Finally, since sundials work with shadows, the calibration machine is designed to utilize shadows as the calibration technique. In fact, for younger children, just learning about how objects cast shadows, and having the opportunity to trace the edge of a shadow, is a valuable cognitive lesson.

**Set Up**
- Set up activity table.
  - Screw on for legs of activity table with wrenches on bottom of table (screwing on legs before taken down will make easier.)
  - Unhook activity table from supply cart and bring to standing position
- Place boxes of scissors, crayons, rulers, and templates at easy access.
- Place wastepaper basket(s) at easy access.
  - Small grey waste basket can be placed in center of activity table
- Make sure battery in the Sundial Calibration Machine has a charge. If not, replace it with the extra battery that is charging on the shelf opposite the white board in the 2003 room.
- Set sun position to the current month.
- Make sure latitude is set for approximately 40° N (Denver is at 39°). This will ensure the sundials made work here in Denver.

When all finished should look like this:

![Activity Setup Images]

**Suggested ways of presenting demo**
- Have visitors construct paper sundials from the templates. Instructions are on the templates.
- Place their sundial into the Sundial Calibration Machine.
- Move the “Sun” from hour to hour on the Calibration Machine. At each hour, stop and have visitors mark the location of the edge of the shadow and label the time.
- Visitor connects the point of the gnomon to each of their shadow marks using a ruler.
- Decorate as desired.
Operating Tips

- When a line forms at the Sundial Calibration Machine, you can often enlist an adult to help you.
- Make sure that the paper gnomon on the sundial is straight up and down. You check this by setting the Sundial Calibration Machine to noon and moving the paper gnomon until the entire shadow is just an edge.
- As you are helping visitors with this activity, it is a great time to talk about the motions of the Sun.
- If you have people that live at different latitudes, be sure to set the Sundial Calibration Machine to the correct latitude for their location. If they do not know their latitude, use a Space Odyssey laptop and the internet to find the latitude of their location.

Questions and Answers

Why doesn’t your sundial always match your watch?
Often, people think that the sundial is wrong. Not true. It is simply that a sundial and your watch are measuring two different things. A sundial measures “Apparent Solar Time” and your watch measures “Mean Standard Time.” Apparent Solar Time measures the actual position of the Sun in the sky. Noon is defined as when the Sun is highest in the sky. There are two main problems with using Apparent Solar Time in a modern society.

The first is that the Sun doesn’t always take the same amount of time from noon to noon. This is due to a combination of the tilt of the Earth and the fact that the Earth’s orbit around the Sun is not perfectly round. Some noon to noon periods are less than 24 hours, and some are more. In order to make mechanical watches and clocks practical, the “day” was averaged out to be exactly 24 hours. This is called Mean Solar Time. It works great for watches, but is not quite in sync with the Sun in the sky.

The second problem is that different locations on Earth have the Sun reach its highest at different times. In fact, before 1883, each town or city had its own local time, usually based on the Sun, or a large town clock. The railroads instituted Standard Time in 1883 (and standard time zones became US law in 1918). In this scheme, the country was divided up into large time zones, and everybody within the time zone agreed to set their watches to the same time. For example, everybody in the Mountain Time Zone follows the time of Denver. So, if you live east or west of Denver, your watch and sundial will disagree. You can show the visitors the “Different Types of Time” charts to explain the above.

Other Cool Stuff to Try

- You can use the Sundial Calibration Machine to show how the Sun moves across the sky at different times of year and at different places on the Earth.
- Showing how the Sun moves at the Equator and at the North Pole is particularly instructive.
Additional Science Content

- At the Equator, every day has equal parts of daytime and nighttime.
- Everywhere else on Earth, the only days where the daytime and nighttime are equal are the equinoxes, around March 20th and Sept 22nd.
- The day with the most sunlight is called the Summer Solstice (around June 21st in the Northern Hemisphere and Dec 21st in the Southern Hemisphere).
- The day with the least sunlight is called the Winter Solstice (around Dec 21st in the Northern Hemisphere and June 21st in the Southern Hemisphere).
- The longest day of the year - that is, measured from apparent solar noon to apparent solar noon - is Dec. 25th. That day is 24 hours and 30 seconds long!
- Sundials were used by the Egyptians - not to tell time, but rather to determine North, South, East, and West.
- Sundials have been used throughout the world for telling time. The earliest records of sundials are in Egypt dating back to 1500 BCE.

Potential Problems

- Running out of supplies. Be sure to check this.
- Though the light bulb is well shielded, it is hot. In the same spirit of reminding children to look both ways before crossing a street, remind visitors not to touch the bulb. Likewise, remind visitors to keep fingers and hands out of the moveable mechanism when it is in use.

Background materials (websites, videos, articles, digital collections links)

- www.analemma.com - Explains the details of the “equation of time”
- http://www.sundial.net/sundial-history.html
- http://www.rnzih.org.nz/pages/sundial2.htm -- definitions and basic types of sundials