William M. Staerkel PLANETARIUM

Teacher's Guide for:

Reasons for the Seasons

Objectives:

- To show why is it hotter in the summer time and cooler in winter.
- To measure the changing altitude of the noon Sun throughout the year.
- To record the changing sunrise and sunset positions through the year and the changing amount of daylight.
- To discover the mechanism that gives us seasons.

This show conforms to the following Illinois state science standards: 12.F.1b, 12.F.2a, 12.F.2b, 12.F.2c. Next Generation Science Standards: 1.ESS1.1, 1.ESS1.2, 5.ESS1.2, MS.ESS1.1

Brief Show Summary:
The show is presented in three major parts:

1. students predict and then watch the sunset position on the current date and then observe and record the changing sunrise and sunset positions at the equinox and solstices. We also can count the number of hours of daylight for each of these times.
2. We then examine how the changing altitude of the Sun affects the weather.
3. Students then explore the reason (axial tilt) for these changes using an Earth globe.

Pre-visit Discussion & Activities:

1. Ask the class why it is cold in the winter. The most common misconception is that the Earth is farther from the Sun. Ask how they know that and how could we find out. If we're closer to the Sun, the Sun will look larger but does the data support this claim? If we were closer to the Sun, wouldn't all the temperatures on the Earth be warmer (above the below the equator)? Does the data support this?
2. Use a diagram of the Earth's orbit about the Sun to briefly discuss the seasons. Misconceptions can result from drawing the Earth's orbit as an oval, implying that maybe we are closer to the Sun in the summer. The Earth's orbit is almost a perfect circle as viewed from above.
3. Begin charting the seasons by
   a) instructing students to watch the position on the horizon of the sunset or
   b) measuring the length of a shadow at noon, or
   c) recording the number of hours of daylight each day.
4. Establish the idea that the Earth rotates by closely watching the shadow of a stick. Why does the shadow move?

Post-visit Discussion & Activities:

1. Discuss with the class what the effects would be if the Earth's axis were not tilted 23.5 degrees. What if it were zero degrees (no tilt)? [no change in seasons] What if it were 90 degrees? This is the case for Jupiter and Uranus respectively.

2. Use a globe and a light source as was done on the planetarium dome to discuss the situation at both poles. How much daylight do they receive at the equinoxes and solstice? You can also use the globe with a short pencil taped on Central Illinois coming straight out of the glove to show how shadows will appear different lengths depending on the season.
3. Shine a regular flashlight on a table at roughly a 70-degree angle and have students describe the spot they see. If the flashlight is mounted somehow, they may even measure its long and short diameters. Then move the light source until the light rays are striking the table at roughly a 25-degree angle. Does the spot change? How? How is this related to our seasons? [Note: many say that, in the summers, we get more "direct rays." While this isn't inaccurate, most don't know what a direct ray is! In the planetarium we say the light is more concentrated in the summer.]

Internet Resources:

- Sunrise & set calculator: http://www.srrb.noaa.gov/highlights/sunrise/sunrise.html
- Listing of holidays https://en.wikipedia.org/wiki/Lists_of_holidays
- Calendar on a playground: http://www.efn.org/~jack_v/AstronomicalCalendar.html
- Sundials: https://www.timecenter.com/articles/when-time-began-the-history-and-science-of-sundials/
- Sundial projects: http://www.sundials.co.uk/
- What causes the seasons?: https://www.livescience.com/25202-seasons.html and https://spaceplace.nasa.gov/seasons/en/ and https://www.nationalgeographic.org/activity/the-reason-for-the-seasons/