Seeley Swan
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Eye on the Environment

Figuring out Fall: Do-It-Yourself Astronomy

By Fiona Brown and Dave Morris, Northwest Connections

Lately, a lot of people have been telling me that fall is their favorite time of year in the Swan Valley. Maybe we are taking special notice this year because it took a little longer than usual to arrive. Maybe we say this at the beginning of every season because we've gotten tired of the previous one and are happy to exchange heat for wind, or cold for wetness. Though it is hard to say what, there is something undeniable about this time of year. "It just tastes good," says Swan Valley resident Steve Lamar.

October 19th tasted especially good. I went outside in the early morning when the stars were still out. The hill, sparkling with frost, could have been reflecting the milky way. I bent down and put my hand to the ground leaving a melted palm print.

As the sun came up over the Swan Range on October 19th, light spread down the hill and the frost receded. You could have pointed to the line between frost and sun with pencil lead. I could hop into winter and back out again. On fall mornings you can really feel your place in the solar system.

The earth spins on its axis at an angle of 23.5 degrees. It is not the physical distance of the earth from the sun that makes the seasons what they are, it is this angle. The earth's aphelion, the point when it is closest to the sun, actually occurs in January. The perihelion, when the earth is farthest away, is in July. However, in July the northern hemisphere is tilted towards the sun. As the earth travels on its elliptical orbit towards winter, the angle becomes less an less direct, and the ground receives fewer photons per square inch. Fall, at its origin, is the changing angle at which sunlight hits the ground.

If my high school math class had been structured around astronomy I might have been more interested in it. I started drawing diagrams and trying to remember how to do trigonometry in order to figure out the exact angle that makes fall- more specifically, the exact angle of the sun on October 19th at say, noon. in the Swan Valley. It was horrible. I still count on my fingers, so I was delighted to find in a book called *Montana Starwatch* that showed how to chuck most of the math and measure the angle of a celestial body in degrees with your hands:

First, stick your arms out straight at the horizon like Frankenstein. Unless, like Frankenstein, you happen to be particularly disproportionate, your fist at arm's length is equal to about 10 degrees of angular measurement. Keeping your elbows locked, and the thumb side of your fist pointing up, one-potato-two-potato your fists until you are pointing at the sun. Multiply the number of fists by 10, and voila!

Another useful benchmark is the full moon, whose width is equal to about half a degree. Also, your outstretched hand, measured from tip of thumb to tip of pinky, is about 20 degrees wide.

Using your hands as guides is also a useful technique when trying to remember where constellations are in relation to each other or when trying to point out constellations to someone else. For example, the Big Dipper is 20 degrees wide, from one end of the dipper to the end of the handle: an outstretched-hand wide, or two fists' width. There is no shame in counting on your fingers. Just like a timber cruiser can learn, with experience, to use her stride to accurately measure a stand, and her arm span to measure the diameter of a tree,

you can learn to use your own body to learn about the cosmos.

You don't have to own a telescope to be an astronomer. If you like, you can check your observations against the numbers calculated by the professionals and see how close you get. By doing a little bit of internet research, Dave discovered that at noon on Halloween the angle of the sun is only 28 degrees- a little less than three fists. By Christmas the sun is only 18 degrees above the horizon. The upshot of this angle change and the shorter winter days is that the solar energy delivered to the Swan Valley goes from 484 watts per square meter at the summer solstice, to 174 at Halloween, to 103 at Christmas. ***(Sources below)***

If there were no tilt to the earth's axis and the angle of light did not change throughout the year, the larches wouldn't turn. Snow would not begin to collect in cirques in the mountains. People would not spend all day chopping wood in preparation for winter. It would be very difficult to decide when hunting season should be. The sun would constantly blaze at the equator and skim past the poles for the entire year, rendering these parts of the planet uninhabitable. The air would probably taste very different.

Solar energy calculator:
http://aom.giss.nasa.gov/srlocat.html

Online-Photoperiod Calculator:
http://www.sci.fi/~benefon/sol.html