LEARNING THE SKY WITH A SMARTPHONE by Harold Suiter

(This article is not written for our experience members, but for beginning members, teachers, and people who have just encountered the website.)

When I was a young amateur astronomer, the world was a different place. There were fewer metal-vapor lamps in 1966, and the electric companies hadn't yet convinced people to believe the dubious proposition that their world was more "secure" if it were illuminated and no one watched. Fewer folks then were terrified of the dark in those days.

Many streetlamps in my small hometown still were ordinary tungsten-filament devices, and hence were forced to carefully cup their light and direct it down toward the ground. What's more, they were sufficiently expensive and difficult to maintain that they weren't located everywhere. As a result, I had no trouble finding a corner of my backyard that was relatively light-free. The stars were visible above me, little diminished by light pollution, and I could learn the sky above my head as it rolled throughout the year. I had a full view of the Milky Way. It was just like living in a planetarium (albeit, a very slow one). Between late fall 1966 and spring of 1968 the sky turned through about 18 months, and at the end I could recognize tiny subsets of the constellations behind openings in clouds.

The old process I used was a variation of the following, and it still works:

1) Obtain a guide to the constellations. For absolute beginners, I recommend H.A. Rey's *The Stars*. There are a number of useful field guides and beginning astronomy books available, but something that is absolutely required is a shallow atlas. The one I used was the very crude Edmund Mag 5 Star Atlas, which I believe has 1950 coordinates. Also available is Norton's Star Atlas, but in my opinion, it is slightly harder to use because of a magnitude 6+ depth. Another favorite is the Bright Star Atlas 2000 by Tirion and Skiff. It too is deep at over mag 6. Another helpful aid is a good planisphere, which is one of those rotating cards of the sky beneath a window. A favorite is the dual-window version sold by Sky & Telescope, which not only has the usual north orientation featuring a good projection of circumpolar stars, but has a rear-side window having a different projection favoring the southern sky. Spend lots of time studying and puzzling these out.

2) Find a particularly memorable geometric shape or bright star, and orient the search for less prominent star figures from there. Few of these shapes are the whole constellation, but just exist as an asterism subset: e.g., the Big Dipper, Orion's Belt, the Northern Cross, the Teapot, the Water Jar in Aquarius, the Pleiades, and the Sickle in Leo. The bright stars are the 20 or so first magnitude "navigation" stars. These stars are distributed loosely around the sky so that you can always find one. There are a few 2nd magnitude additions that occupy the corners of asterisms so that the list expands to about 30. Examples of these signpost stars: Sirius, Polaris, Vega, Deneb, and Arcturus. Polaris is one of those 2nd magnitude interlopers that you must learn about in spite of its being a less bright star in a dim constellation.

3) Pay special attention to the southern horizon. Constellations visible there seem to peek above the horizon only briefly during the year. Miss one and it's gone until next year.

4) Generally spread your area of knowledge from the easily-recognizable asterism or star to the rest of the constellation. For example, fill in Ursa Major from the Big Dipper, and then spread from Ursa Major

to smaller, more-difficult, constellations Canes Venatici and Leo Minor, coming on Leo from the North. Eventually, using other easily recognized starting-place asterisms, the whole sky is yours.

Now, that is the old way. What I'm going to tell you about is a new method that leans heavily on the nearly ubiquitous smartphones. Most of the smartphones have a planetarium app that hooks into the orientation sensors in the form of low-precision gyroscopes, accelerometers, and magnetometers contained in the smartphone itself. These are micro-electromechanical system chips MEMS for short, and they turn the smartphone into a kind of low-grade Star Trek "tricorder." For Androids, Google Sky Map is perhaps the best known. It was even pre-loaded in older Androids. Apple probably has equivalents, but since I've only owned droids, I'll limit my discussion to them. Another very good planetarium is SkEye by RJ Harshad, and it will work outside at night because it's naturally dim. You also have some control of the screen brightness built into the phone controls.

First of all, you've got to verify that the internal compass in your smartphone is working correctly. If you use a north-south rectilinear street grid for rough directional alignment (just take Sky Map, or whatever, out to the curb and look at the northern horizon as if through a window) and it is out of whack, it will be necessary to recalibrate the internal magnet sensor. Use the figure-8 motion well described by the video in

http://www.s3sensor.com/en/s3/calibration/recalibrate/index.html

to perform this calibration. It must be actively using a magnetic app at the time the figure eight is done (it's easiest to just use the planetarium). Please note that this calibration procedure may not work on all smartphones, but it at least has been seen to work on some. It probably depends on the MEMS chip and the method of direction finding.

Assuming your smartphone gave a more-or-less correct direction or the calibration fixed it, it may still be off by as much as ±20 degrees from the N-S street grid here in the continental US (it varies long-term with time). The reason is the *magnetic declination*, sometimes called the magnetic deviation or correction, which is the difference between magnetic north and true north. An explanation is given at http://magnetic-declination.com/ as well as a map.

If you make sure your GPS is running and that it has a location for you, the default condition of Sky Map does this correction automatically (presumably it looks up the declination in a database or fits it to a model). You can turn the magnetic correction off, but I can't see any reason why anybody would ever do so. I cannot find any menu entry of SkEye that indicates it does this correction, but perhaps the correction is done quietly all the time in SkEye, or you have to pay for an advanced version. In any case, there is a method where you can align an object to a telescope view. This assumes you are using the smartphone as a virtual finder. The 3-axis encoding of a smartphone is probably too coarse to find an object to great precision. Also, the difficulty of keeping the smartphone dry and powered for a long time make using it in this way a bit of a stretch. However, it is probably a preview of things to come down the commercial pipeline in a few years. I can visualize a ruggedized accurate version of a virtual finder with variable power in the future, maybe even communicating with digital setting-circles and a go-to drive, and there is no reason to point it down the tube. It would still demand a circle setup on two stars, but

would discard the interference-prone magnetic sensor effects. It could be right next to the eyepiece. But I digress.

The next thing is to improve the phone's steadiness and resistance to tilting. The need here is a short wooden spine (a 1x4 of about ten inches or so) at the end of which is a right-angle phone mount. The finished device is held with both hands on the spine and the phone is sighted from the end of the spine. The net effect would be of your great-grandparents stereoscope used to view 3D photos. Here the dual optics would be placed by a single sighting aperture. Sticking the phone to the plate could be helped by finally using those stupid belt clips no one trusts on their belts. I realize that not everyone (especially those in my age category) can focus as close as ten inches. I suggest using reading glasses if you don't already have bifocals and peering over them for viewing the sky. It is very helpful if you can attach your phone-mounting upright to some sort of swivel, so that you can adjust out the inevitable residual azimuth error caused by magnetic correction being misapplied or just poorly measured.

My final suggestion has to do with magnification. I find that magnification somewhat smaller than reality is helpful. I know it doesn't make sense, but you can find things easier if you can see more of the surroundings of the constellations. My Razr HD has a screen size of about 3.65 by 2 inches, and at 10 inches from my eye, that is about 11 by 20 degrees, about the size of the Big Dipper. It helps if there is a little space around the target. I find there is little difficulty scaling the image, but you may be different.

If there is an option, turn the horizon and cardinal points on. If you can, also turn down the magnitude limit and squelch the multitudinous interfering labels like Messier and NGC objects. Go someplace where there are no streetlights in direct view so that you can at least see a few stars. The actual viewing requires little explanation. You look in a certain direction and try to match up the stars on the display with the real thing. You look at the constellation name, and there you are.

There is a disadvantage when following the real sky. The constellations rotate once per day with respect to the horizon or, if you prefer, once per year if you are looking at the same time of day (usually at nightfall). If you wait, say, a couple of months before you take another look at the sky, the constellations have rotated by 60 degrees and your recognition might be compromised. The second advantage of a smartphone is "time machines" or "time travel" wherein you can follow the rotation and movement of the constellations throughout the year. They also automatically rotate the view, unlike the paper maps that I looked at when growing up. Orion is always upright on the map, where in the real sky he goes from leaning on the left side at the eastern horizon to on the right side in the west.

In conclusion, the smartphone is a useful tool to learn the constellations as long as it is properly calibrated and held. It is almost as good as a friend to point them out. A personal computer planetarium may well allow similar displays, but they don't turn with you to paint the constellation against the sky.