

## ***Star Guide Astronomy Training***— Video available at: <http://tinyurl.com/starguidetraining>

There are three components to this session: guide etiquette/procedures, telescope design, and a general astronomy overview. We will begin with personal information sharing to get to know each other better as there may be situations where substitutions of a partner or help with some of the operations is needed from another Star Guide.

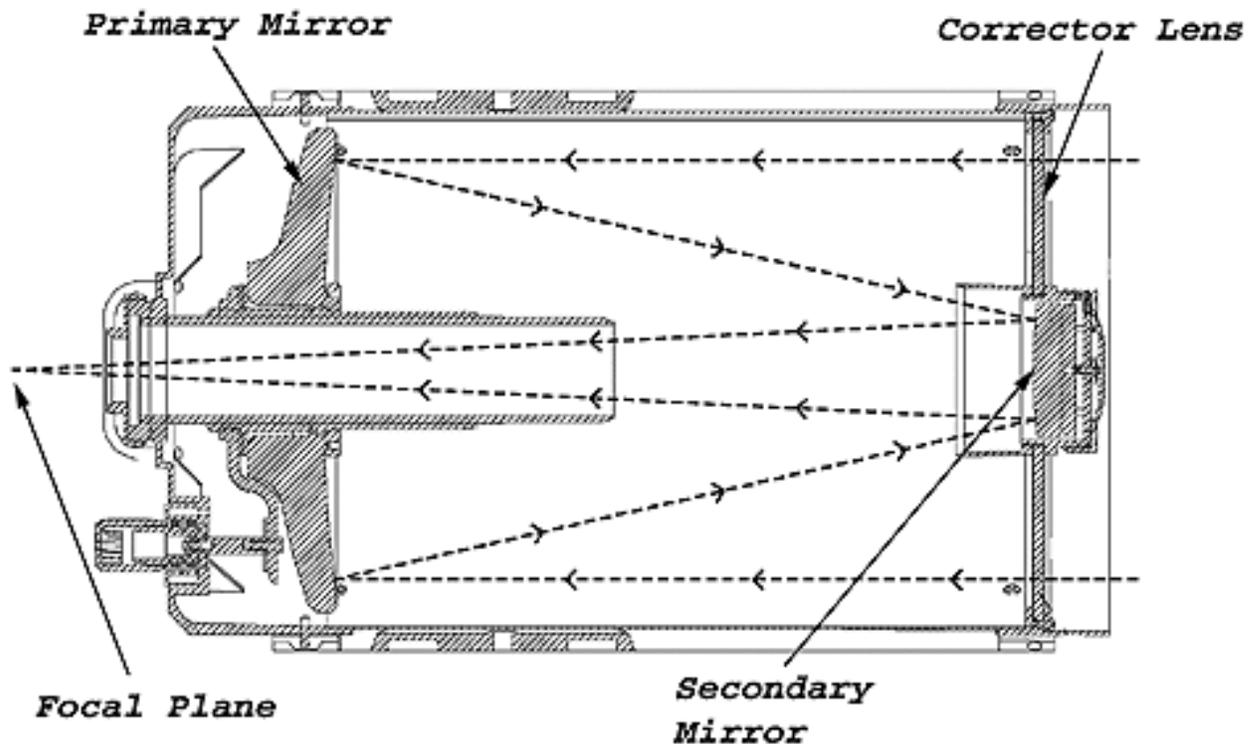
### **Star Guide Etiquette/Procedures:**

- Suggest that you stop by the SJO a day or two ahead of your assignment, and use the *SkyX* software to produce a viewing list of 3–4 dozen celestial objects. Do a bit of research with a planetarium app like *SkyPortal* free from [www.celestron.com/support/celestron-skyportal](http://www.celestron.com/support/celestron-skyportal). You might make some notes to share with the visitors or try *SkyPortal*'s audio descriptions.
- Arrive at least 30 minutes early to open up the roof so the telescope can begin reaching ambient temperature, get the various electronics turned on, check out the telescope for proper operation, etc.
- You will meet your group in the parking lot to the east of the SJO on Adams Blvd.
- Walk them down to the SJO cautioning them of slippery gravel, especially when making the left turn off the path directly to the building.
- When greeting the visitors, be positive in welcoming them, describing the celestial objects they'll see, and the fun experience you are going to provide. Mention that if they ask a question that you don't know, you'll look it up on the Internet.
- A common situation will be whether to hold or cancel the viewing session due to bad weather and/or sky conditions. In the summer, we often have late afternoon thunderstorms that leave lingering clouds past the starting time. They often clear out after midnight, but that's too late to start a session. There's no firm rule but to use your own judgment. We will be asking for a contact phone number when a group reserves the SJO so that you can communicate with them when the sky conditions are an issue. Good astro weather site: <http://clearoutside.com/forecast/38.13/-105.47?view=current>
- If someone walking by wants to join the session, ask group if it's ok with them.
- Topics to Avoid: religious based questions. My response is that the Bible is a book of faith, not a science textbook. Also, do UFOs exist? My response is maybe but why don't they make direct contact with us instead playing cat-and-mouse?
- Who was Smokey Jack? She was passionate about preserving the natural environment of the Wet Mtn. Valley, especially the night sky. She formed an incorporated non-profit organization called Dark Skies, Inc. in 1998. The first major success was collecting donations to fund the replacement of the 40+ unshielded street lights in Westcliffe with shielded ones in 2001. Unfortunately, she passed away in 2004 from cancer. Visit the observatory webpage at: <http://wetmtdarkskies.org/pages/observatory.htm> for more.
- How did the SJO become a reality? Jim Bradburn, the Dark Skies president, was instrumental in getting location, foundation, building materials, and the roll-off roof donated by local businesses. He donated the telescope and obtained a cost-based price for the computerized mounting. Labor in its construction and operation has been volunteered.

### **Telescope Design:**

- Basic refracting (glass lens) design: most people associate astronomy with the classic refracting telescope with a lens at the front and the eyepiece at the back. But professional observatories moved away from this design in the early 1900's in favor of the mirror design.

- Basic reflecting (mirror) design: most telescopes used by professional observatories are the reflecting design where the main (primary) mirror is at the bottom of a tube reflecting the gathered light back to the front of the tube. There a small “secondary” mirror either turns the light to the side of the tube or back through a hole in the primary mirror where it enters either an eyepiece or an instrument to analyze the light.
- The SJO’s telescope is of the mirror design but also uses a weak lens at the front to correct an optical issue with the deeply curved primary mirror, holds the secondary mirror, and prevents dust from entering the tube assembly. This sealed, compact design is known as a Schmidt-Cassegrain (named after the two men who originated the design). A popular design with amateurs because the compact tube allows for easier transportation, more stable when viewing at high powers, and allows for a smaller observatory.

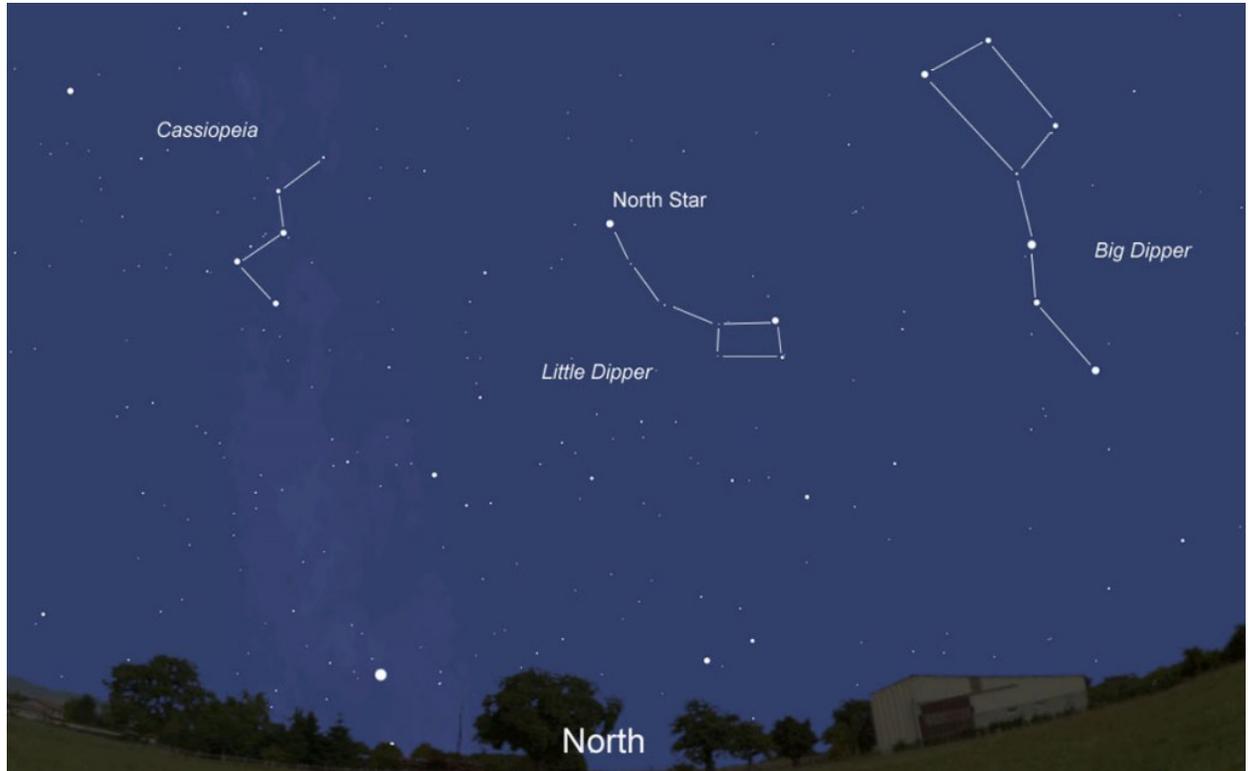


- The mounting that carries the SJO’s telescope tube is a marvel of modern technology. With the *SkyX* software determining the precise location of the desired object, it sends that information to the mount’s drive motors to move to that location and then to begin “tracking” where the motors constantly adjust for the Earth’s rotation.
- If someone wants advice on buying a telescope, refer to them to: [telescopes.com](http://telescopes.com)
- For the viewing sessions, we have decided to use a digital camera system that displays the image on a large flat screen monitor rather than use an eyepiece. This allows all the visitors to see the image at the same time rather than waiting for a brief turn at the eyepiece. Plus the camera is capable of building up an image of a faint object many more times than the human eye can see. Plus the image will be in color! Very few celestial objects are bright enough for the unaided eye to perceive color.

## General Astronomy:

- The most common celestial objects that you will be showing the visitors are: the Moon, the planets, stars in open clusters and globular clusters, nebulae, and galaxies.
- Moon: the view of the craters is one of the “wow” moments that many viewers experience. They are the result of impacts from asteroids and comets, mostly from several billions of years ago. Only a few small ones have been recorded as occurring in the age of the telescope. Careful observing of the shadows cast by the walls of a crater will show movement over a period of hours as the Moon slowly rotates once during its 29.5 day orbit around the Earth.
- Planets:
  - Mercury is difficult to view after the Sun sets behind the Sangres and the SJO’s roof is in the way, too.
  - Venus, when it’s orbit places it in the western sky at sunset, will show a crescent phase like the Moon because Venus is inside the Earth’s orbit.
  - Mars is so distant that even at its closest, little can be seen as far as surface detail is concerned. Consider not showing it unless asked.
  - Jupiter, even though further away than Mars, often shows wonderful color bands around its sphere. And the four largest moons are called the Galilean satellites, after Italian astronomer Galileo Galilei, who first observed them in 1610. They are easily visible and can be seen to change position over a period as short as an hour.
  - Saturn is easily the biggest “wow” object and is often given credit with someone getting into amateur or even professional astronomy. Suggest that you save Saturn for the end of the session, as the old saying goes: “*Save the best for last.*”
  - The remaining two planets, Neptune and Uranus are so distant as to only appear as small discs even under high power. Consider not showing them unless asked.
- Stars: about half of all stars are actually in a system of 2 (binary), 3, or more other stars in complex orbits around each other. Also many stars are variable in their brightness, often with a predictable cycle. Fortunately, our sun is an average, ordinary, and stable star over vast periods of time. Some stars are members of “open clusters” like the easily seen *Pleiades* or *Seven Sisters*, while others are grouped in dense “globular clusters” that contain 100,000’s of stars in a small area. Viewing them at high power in a telescope is impressive.
- Nebulae: can be either white by reflecting or emitting light or they can dark dust-filled clouds that block stars behind them. *The Great Rift* in the summer Milky Way is an example of a dark nebula. The *Great Orion Nebula* in the winter and spring evening sky is a showcase level object of an emission nebula.
- Galaxies: are located outside of our Milky Way home galaxy. The Hubble Telescope has recorded thousands within a tiny area of the sky (about like a BB pellet held at arm’s length) that indicates that galaxies must number in the billions, each with millions to billions of stars. The camera system should show the spiral arms on the brighter galaxies.

- Where's the *Little Dipper*? This is a common question, here's the answer: the tip of the handle of the *Little Dipper* is the *North Star* or *Polaris*. The *Little Dipper* curves towards the *Big Dipper* such that at sometimes of the year, one dipper appears to be pouring into the other. A good thing to share: the "pointer stars" of the *Big Dipper*, Dubhe and Merak, point at the *North Star*. These stars are close enough to the *North Star* that they never set.



*Position in early spring, shortly after dark.*

- Also, the two dippers are **not** constellations, but parts of larger groups of stars making up the constellations of *Ursa Major* and *Minor*, or in English, the *Big Bear* and the *Little Bear*.
- Are the *Pleiades* the *Little Dipper*? No, see above. They are an open cluster. The seventh star of the *Seven Sisters* is difficult to see unless one has good vision. The *Pleiades* is used in the logo on Subaru cars.
  - Why do stars twinkle? The narrow beam of star light is easily distorted by the movements in the Earth's atmosphere. The primary reason for placing the Hubble Space Telescope in orbit around the Earth so it's above the atmosphere's distortion. Modern technology has allowed professional observatories to tune out much of this problem producing images even better than the Hubble.
  - Astronomy vs. Astrology: astronomy is based on the scientific method of multiple testing by multiple persons to establish a consistent result that can be usually be defined mathematically. The scientists are usually degreed to the PhD level. Astrology is the belief that the position of the planets against the background stars (constellations) foretells an individual's future. Anyone can be an astrologer by claiming the title. The readings or horoscopes for a particular individual vary widely from one astrologer to another, and they are nearly impossible to prove their accuracy.

•Estimating degrees using your fingers and hands:

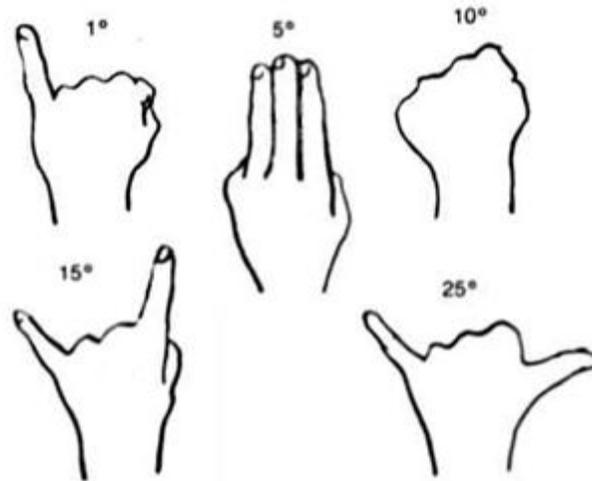
Stretch your thumb and little finger far apart. The span from tip to tip is about 25 degrees

Do the same with your index finger and little finger. The span is 15 degrees

Clench your fist at arms length, the width is 10 degrees

Hold your three middle fingers together; they span about 5 degrees

The width of your little finger at arm's length is 1 degree.



Fun fact: the full Moon can be covered, twice, with the little finger.