# Tips for Observing

## Astronomy 101

***Use red light to preserve your night vision.*** Red light doesn't affect human night vision as much as other colors. Keep your flashlight as dim as you can while still being able to read your charts.

***Use averted vision*** to harness the eye's most sensitive cells and see much fainter. (See "Averted Vision" below.)

Try to observe objects when they're ***near the meridian.***

***Binoculars can see a lot,*** including many objects that large telescopes can't! Big telescopes are limted to tiny pieces of sky. Binoculars let you see the big picture.

***Start at a low magnification*** to find the field, then switch to higher magnifications to view the object.

***Have patience.*** The longer you observe, the more you will see. If you wait at the eyepiece for a while, you'll catch the moments of good conditions, where tiny details become visible and faint objects pop into view.

***Learn to judge the conditions.*** Faint objects like galaxies will be most visible on nights with good transparency, while small objects like planets and planetary nebulae are best on nights of good seeing.

## Some Definitions

**Transparency:** A measure of how clear the air is. Even when the sky looks clear, there can be lots of haze, moisture, and/or dust in the air that washes out astronomical objects. The better the transparency, the fainter you can see.

**Seeing:** A measure of how steady the air is. Telescopes magnify everything they see, including turbulence. The worse the seeing, the more stars twinkle. The better the seeing, the smaller the details you can see, especially on bright objects.

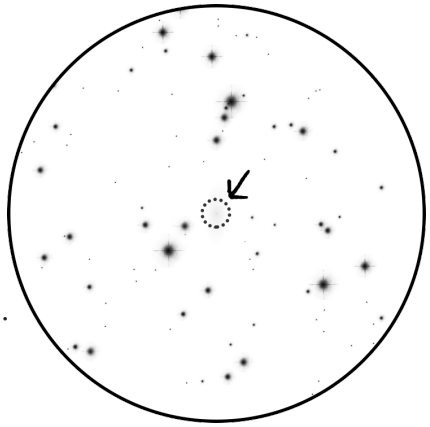
**Meridian:** An imaginary line drawn from Polaris (due north) to the southern horizon, passing straight overhead. When objects are on the Meridian, they're the highest in the sky that they'll get from your location.

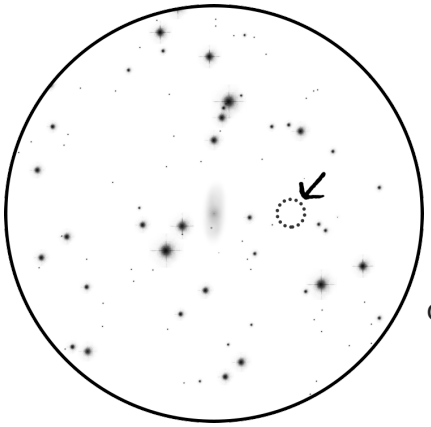
***Good seeing and good transparency don't often coexist.*** Generally, in South Texas, winter has bad seeing and good transparency — especially in the wake of cold fronts. Summer has good seeing and bad transparency, after the Sun evaporates water from the Gulf which moves inland as stabilizing haze.

## Averted Vision

Averted vision is perhaps the most valuable technique in an astronomer's arsenal. The center of our retina has many "cone" cells, which are good at color vision, but bad at night vision. Closer to the edge of the retina there are many "rod" cells, which can't do color vision, but are really good at night vision. By looking off to the side of a target instead of straight at it, we can make the light fall on the most sensitive area of the retina, where all the rods are. Many, many deep sky objects will not be visible with direct vision, but will suddenly appear brightly when averted vision is used. Once you've tried it a few times, averted vision becomes second nature, and you'll find that it's actually more difficult to stare directly at an object than it is to let your eyes roam! It's best to look "ear-ward" (to the right if you're using your right eye) so that you don't accidentally put the object in your blind spot.

Staring straight at an object might make it disappear...





Instead, avert your gaze, and look over here!

## Tips for Faint Fuzzies

***The less light pollution, the more you will see.*** Sky darkness is far more important than aperture. A 6" telescope under dark skies will see more than a 12" telescope under city skies.

***Set up in the darkest area possible,*** and try to block out extraneous light. As a good rule of thumb, your night vision is limited by the brightest thing you can see. If the brightest thing you can see is the sky, then you're good.

***Try using an observing hood when observing extra dim stuff,*** or throw a towel over your head to block out the light from the sky and reflected light from the landscape. A T-shirt put on "upside down" works well as an observing hood.

***Save difficult objects*** for nights with good conditions.

***Sometimes faint objects will pop into view*** for a split second when you first pan over the field, or tap the telescope to cause movement.

***Human vision is very sensitive to small differences in oxygen.*** Slow, deep breathing can help deliver oxygen to the eyes and improve night vision. (Fast hyperventilation will ***lower*** your oxygen levels, and cause your night vision to worsen rapidly.)

***Get up and stretch your legs*** every now and then. You might be surprised when you return to the eyepiece. Sitting or standing for a long time can cause blood flow to slow and worsen your night vision without you even realizing it.

***Wear sunglasses during the day*** to avoid bleaching your rhodopshin (a chemical that helps night vision and breaks down in bright light).

## Telescope Math

FL = Focal Length
TFOV = True Field Of View
AFOV = Apparent Field Of View

$$Magnification = \frac{FL_{telescope}}{FL_{eyepiece}}$$

$$Focal\,Ratio = \frac{FL_{telescope}}{Aperture}$$

$$Exit\,Pupil = \frac{FL_{eyepiece}}{Focal\,Ratio}$$

$$Brightness\,Factor = \frac{\left(Exit\,Pupil^2\right)}{\left(Eye\,Pupil^2\right)}$$

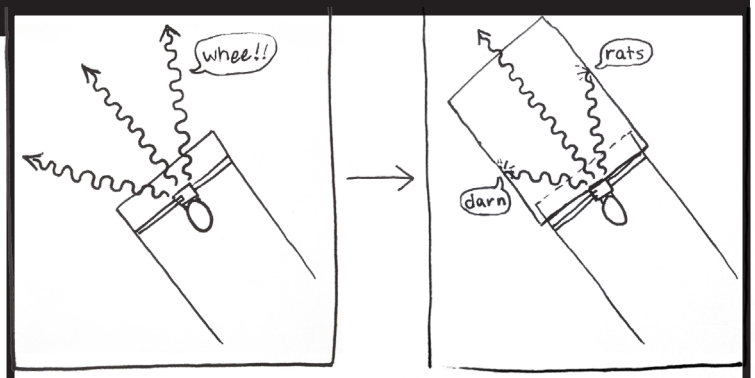
$$TFOV = \frac{AFOV}{Magnification}$$

***Most dark adaptation occurs in the first 45 minutes after dark,*** but dark adaptation will continue to improve slowly over the next few hours if you're in a sufficiently dark site and avoid light.

***Power naps are your friend.*** Sleep can be very important when it comes to seeing faint fuzzies. If you're not seeing as much as usual, try a nap and then ***get back up*** afterward to continue observing.

## Defeating Dew

It's a fact of life that on humid nights, dew will condense on unprotected optics and make the view dim and fuzzy. Primary mirrors are safe from this, but secondary mirrors and eyepieces are exposed enough that they'll dew. Telescopes with front lenses are at risk, too. To prevent dew from forming, try making a dew shield for the front of your telescope out of rolled-up foam or cardboard. Once dew has formed, you can use a hairdryer to temporarily get rid of it, but be careful not to overheat or you'll cause severe "tube currents" which blur the image.




*Telescopes dew because they radiate heat into space (which doesn't send much heat back).*

*Dew shields block the heat from escaping, so the scope doesn't cool to dew point!*