What's up in Astronomy By Eric Erickson

Offered Title: Air – Good for Life – Bad for Astronomy

I don't think about it. I go about my daily activities and just don't notice. I breathe.

I hear you saying to yourself, so…? It's normal that we breathe without noticing, of course until we struggle to catch our breath while racing up Enchanted Rock.

Our life giving and sustaining atmosphere (for those organism's dependent on oxygen) is composed of 78% nitrogen and 21% oxygen, with the remaining 1% mostly argon. I love my air, especially hill country air. Have you ever noticed how the air in different parts of the country has its own aroma? Mixed hardwood forests of the north have a different aroma from our juniper and oak forests, and from the piney east Texas forests. Sorry, I digress.

Our atmosphere is our life and our protector from the dangerous radiation beyond it. It provided for countless generations of human existence, and the eventual development of astronomy. Those first astronomers certainly noticed that nearly all stars twinkled at times, and a few didn't twinkle. They were not aware of it right away, but they were distinguishing twinkling stars from non-twinkling planets. The Babylonians figured it out in the second millennium BCE.

Twinkling, caused by our atmosphere, did not hinder early astronomer's observations.

Then came the telescope.

For a while, telescope optics were not good enough to be bothered much by atmospheric conditions, but as telescope design improved and their size increased, our air became apparent. It started to create havoc with telescopic images. How does it do this, and can anything be done about it?

Think of our atmosphere as a very, very thin fluid. Like a fluid, air will move around, depending on conditions, except air is much more sensitive to slight changes, especially changes of temperature. Air responds to temperature changes by moving, instability in the form of ripples, breezes, gusts, and rotation. This is most apparent in the Troposphere, from sea level to 10 kilometers (32,808 feet) and causes instability of magnified (telescopic) images. The image pops in and out of focus and even dances around (twinkling stars). The affect is unfortunately increased in larger telescopes.

The first solution was to build telescopes at high altitudes, up to 18,000 feet, to avoid as much atmospheric instability as possible. It helps a lot, but altitudes above 16,000 feet present challenges for humans as the air is thin and it's really COLD!

The next solution is called adaptive optics. These telescopes generally use a many segmented primary mirror, where each mirror segment is computer controlled, and is instantly adjusted (deformed) to compensate for atmospheric fluctuations. It works!

The best solution is putting telescopes above our atmosphere, in space. Way more expensive but no interference by atmosphere.

What's in the Sky?

After Sunset: Catch 4 bright planets from east to west in the southern sky…Mars, Saturn, Jupiter, and Venus