## The Ionosphere

# The Great Radio Prism in the Sky

**The ionosphere is a thin layer of gases — mostly oxygen and nitrogen — that exists at very high altitudes, so high that the International Space Station cruises through its outer reaches.**

During the daytime, the intense radiation from the sun strips electrons from the gas atoms and creates charged particles called ions. These ions tend to sort themselves into regions, or layers, in the ionosphere. We call these layers D, E, F1, and F2.

What makes these high-altitude ions special is, if you pack enough of them together in one place, they can act like prisms to radio waves. Just as a prism bends light, the ionosphere can bend radio signals back to Earth — and when that happens, the signals travel great distances. The ionosphere makes long-distance radio communication possible.

The way a radio signal behaves in the ionosphere depends on a number of things, but the frequency of the signal is a major factor. If the frequency is too low, it may be absorbed in the lower regions of the ionosphere, and travel only a short distance. If the frequency is higher, the signal may travel all the way to the F regions, be bent back toward the ground, and then bounce back up again to the ionosphere — and down again, and up again, until suddenly the signal is thousands of miles away from where it originated.

The ionosphere is different at night, though. Without sunlight to create ions, the lower regions disappear and the F1 and F2 regions merge into one region simply called “F.” The ionosphere can still bend signals back to Earth at night, but these are usually only signals at frequencies below about 10 MHz.

Regardless of whether it’s day or night, if you go higher in frequency, above about 50 MHz, the radio prism effect of the ions stops working. Instead, these signals zoom directly into outer space. That’s one of the reasons why spacecraft use VHF, UHF, and microwave frequencies. They need reliable communication paths that won’t be blocked by the ionosphere.

Thanks to the ever-changing ionosphere, hams can communicate around the world with just a wire antenna in a tree.

## An AM Lesson

Have you ever wondered why the AM radio in your car only receives local stations during the day? That’s because those low-frequency signals are being absorbed in the D layer of the ionosphere. The D region is dense, relatively speaking, and it can act like a sponge to lower-frequency signals that aren’t energetic enough to punch through.

The next time you’re in your car at night, take a spin through the AM signals and you’ll hear a big difference. The D and E regions are gone at night, leaving AM broadcast signals free to travel hundreds of miles and even farther. You’ll hear one signal after another — so many that they often interfere with each other.

Listen to an AM radio at dawn, and you’ll hear an amazing transformation. As the sun rises, distant signals grow weaker as the lower regions of the ionosphere return in the light of the new day. Within an hour or so those lower layers will soak up the AM signals again, until only local stations remain.