

# Ask an Elmer

**This month's question: "What is the Ionosphere and what's it do?"**

If you have an interest in Amateur Radio, there's no doubt that you've heard of HAM Radio Operators who talk on their radio's to friends across the U.S., or possibly even talking to other HAM's in "exotic lands" half way around the world. Have you ever wondered how this is possible? The short answer to this question is, Amateur Radio Operators are able to bounce radio waves off of the "Ionosphere" back down to earth, many, many miles from their locations.

How is this possible? I'll break it down for you. The "Ionosphere" consists of 4 layers of the earth's atmosphere during the day and 3 layers at night. These "Ionospheric Layers" are referred to as the "D" layer (30 - 55), "E" layer (55 - 90) and "F" layer (90 - 240) miles above the earth. During hours of daylight, the "F" layer splits into two layers which are called the "F1" layer and the "F2" layer. The "E" layer is denser in electrical particles than the "D" layer, the "F" layer is denser in electrical particles than the "E" layer and the "F2" layer is denser than the "F1" layer.

Dense? What do I mean by dense? Layers of the "ionosphere" are filled with electrical particles called "ions". The "D" layer being the least dense and the "F" layer being the densest. You've most likely heard HAMs talk about solar activity or sun spots. Have you wondered why they're concerned about what the sun's doing? The answer to this is fairly simple. The sun's rays are responsible for charging the electrical particles in the ionosphere. The more sun spots there are on the sun, the more dense the ionosphere becomes.

Ok, those are the basics. Now, what good is the Ionosphere? Well, the ionosphere allows us to talk on our radios to far away places. How's it that done? On HF frequencies (160 meters through 10 meters..and on rare occasions, 6 meters), we bounce our radio waves off of the ionosphere and back down to earth, normally from the upper end of the "F" layer (this is called "skip"). It is also possible for your signal to bounce to the ionosphere and back to the earth over and over again. This process is called "multi-hop". From each "hop", it's possible to talk up to 1500 miles,

depending on your "take off angle" or "angle of radiation" (More info about "take off angle" in next month's "Ask an Elmer"?). The distance your signal travels from your antenna to where it first returns back to the earth is called "skip distance".

Now you're probably wondering...why do we rely on the "F" layer when there's also a "D" and "E" layer? That's because, as mentioned earlier, the "F" layer is the densest in electrically charged "Ions". When our HF signals hit the less dense "D" or "E" layers, they pass right through, but because of the density of electrons in the "F" layer, our radio waves can't pass through and are reflected back to earth instead.

Wait, there's more. As you know by now, the more activity there is on the sun, the denser the ionosphere becomes. As the ionosphere becomes more and more dense, we're able to bounce higher and higher frequencies back to earth. As a rule of thumb 160 or 80 meters are generally "open" in the early morning and late evenings and pretty much all night long. As the sun rises and charges the ionosphere, 40 meters opens up, then 20 meters and possibly 15, 10 or even 6 meters when the sun is near its daily peak.

Generally, when solar activity is low, we're only able to regularly "skip" signals 20 meters (14.350MHz) and below. On the other hand, when there's lots of solar activity, we find that 15 meters (21 MHz), 10 meters (28 MHz) and 6 meters (50 MHz) "open up" and allow us to "skip" long distances...sometimes all night long.

Have you ever heard HAM's talking about the HF bands being dead and didn't have a clue what they were talking about? When solar activity is just right, and we're able to talk for hours on a band, we say that band is "open". When solar activity decreases and reliable long range communications no longer exist, we say the band is "dead".

As you can see, as Amateur Radio Operators, we live for a "Sun Spot" charged "ionosphere"!

73, and as always, happy HAMMING!

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