Teacher's Guide

AM Radio Ionosphere Station

Introduction

Above the earth's surface, a layer of charged particles has been used, since the turn of the century, to reflect radio waves for long distance communication. Radio waves, with frequencies less than about 10 megaHertz, are reflected by the ionosphere. They are used for military and civilian 'short wave' broadcasting. The properties of the ionosphere can change dramatically with daytime transmissions being noisier than night time ones. Solar flares also change the reflectivity of the ionosphere. This AM radio project will let students detect and study some of these changes.

Objective

Students will construct an Ionosphere Monitor by using an AM radio to track solar storms and other changes in ionosphere reflectivity.

Procedure

1) Break the class into equal groups and have one person in each group bring an AM radio to class.

2) Each group creates a graph of the AM band from 540 kiloHertz to 1700 kiloHertz marked every 50 kiloHertz or so over a 1-foot span.

3) Remove the volume control knob and place the paper disk over the shaft, then replace the knob. Tape the disk onto the radio and mark its edge with the numbers 0-10 counterclockwise.

4) Have the students slowly scan through the AM band and note the location of the station on the graph. Note its loudness by the number on the disk that makes the station hard to hear.

5) Identify the call letters and cit of each station you find.

6) Have the groups compare their results to create a combined master plot of the AM band. Locate the most distant station you can hear and its distance in miles from your school.

7) Select a location in the band on the low end between stations. Note the kinds of 'noise' you hear in a journal log for that day. Lighting storms will sound like occasional pops and crackles. Electronic noise will sound like humming or buzzing.

8) Changes in the ionosphere near sunset or sunrise will be heard as a sudden change in the loudness of the background noise. New distant stations may suddenly become detectable. Note the time, the location on the plot, and the city or call letters. This will take some detective work.

Materials

—An AM radio with a tuner knob and a volume control knob.

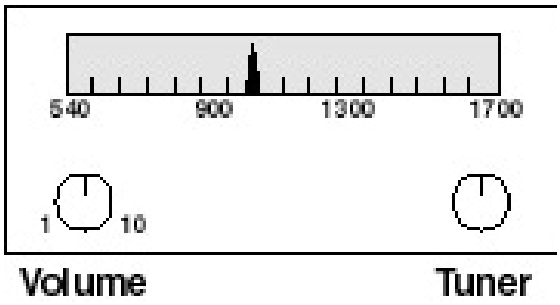
—A paper disk with a hole punched in its center to fit over the volume control.

For more things to do, advanced students may want to visit:

RadioJove at
http://radiojove.gsfc.nasa.gov
INSPIRE at:
http://image.gsfc.nasa.gov/poetry/inspire

Conclusion

Students will learn that a simple everyday device can let the listen-in to invisible changes in their environment caused by solar activity.



Note:

On the volume control dial, you want to affix a circular scale so that when it is turned to '1', you are not very loud, and on '10' the radio is at maximum volume. When you are studying faint stations, you will typically have the volume control turned 'up' to hear them, so that the scale running from 1-10 will tell you about how loud the weak station is so that you are JUST able to hear it.

Online Internet resources you may fine helpful:

Today's Solar Activity:

http://umbra.nascom.nasa.gov/images/latest.html

Space Weather Forecasts:

http://www.sec.noaa.gov/today.html

http://www.sec.noaa.gov/index.html

This makes a good classroom project and homework assignment (watching the changes during and after sunset). It is also a good long-term science fair project, if you also correlate solar activity with the changes in the daytime radio noise loudness, and faint station reception. Solar flares will cause short-wave 'drop outs' and impared reception of distant radio stations during the daytime, lasting for several hours.

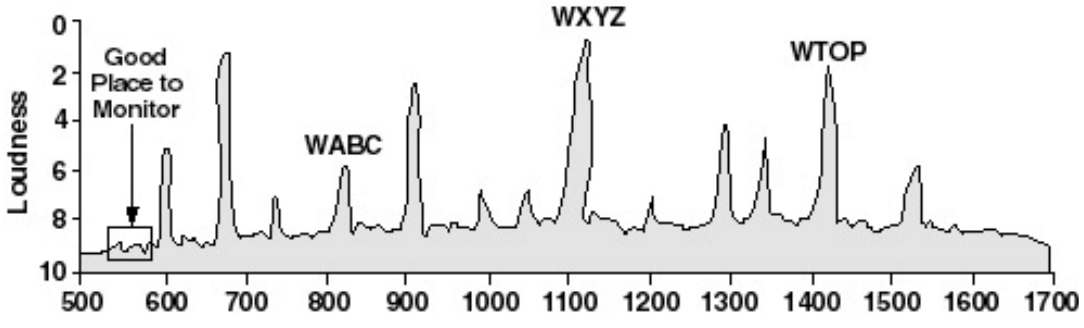
Sample Journal Entries:

April 5, 1997 10:45 EST Cambridge, Massachusetts

"We listened to a radio frequency setting of 610 kilo-Hertz. The noise seemed pretty steady at a loudness of 8.5, but every 10 seconds or so we heard a sharp crackle of noise. We think this was a distant thunder storm, and our TV weather report says that thunder storms were in progress in Kansas at the time."

February 6, 1997 6:00 PM EST, Dayton, Ohio:

"Sunset happened about 35 minutes ago, and I selected the same frequency we listened to at in school, to listen for the day/night changes. I can hear a faint station we did not hear in the daytime, and the background hiss is now less loud. Instead of 9.0, I have to put the volume control over to 9.5 to hear it at all. "



Frequency in kiloHertz (1000 cycles per second)

$$\text{Wavelength in meters} = \frac{300{,}000}{\text{Frequency in kiloHertz}}$$