Observing the May 20th Solar Eclipse Non-Visually

The upcoming solar eclipse provides us with a rare opportunity to engage students by exploring many different aspects of solar radiation. The Sun affects us in many ways and most are not visual. As a result we can use other strategies to observe the Sun rather than just visual techniques such as using a Mylar filter to observe the Photosphere or an H-alpha filter to observe the Chromosphere which are discussed elsewhere in this magazine. I've also found that students are often more interested in things that they can't "see" and this affords us an opportunity to capture this interest. Let's explore a few of these techniques briefly now.

Brightness and Light from the Sun

Photocells: Many students are aware of photocells and their use in making electricity. Photocells measure the light intensity and convert it to a voltage. The brighter the object the more voltage produced. Photocells are available at Radio Shack or other electronics stores and are relatively inexpensive. You must point the photocell directly at the Sun the whole time you measure the changes in brightness, otherwise you are recording changes in pointing position! You can do this by looking at the shadow of the photocell and making sure it is the exact shape of your cell, otherwise you are pointing off the Sun and not recording the total intensity of the Sun.

Then attach a meter to the two leads from the photocell and read the voltage. If you have access to a digital voltage recorder, that would be even easier. Many of these are available, including my favorite from Vernier Software.

If you don't know much about these, ask your high school science/physics teacher. This is a device that most schools will have and they can help you with this project. After you record the voltage change every minute or so, make a graph and review your results. You should see a drop in voltage associated with the eclipse and a rise in voltage afterwards.

The IBT: A second experiment involves making a simple radio telescope known at the Society of Amateur Radio Astronomers (SARA) as the Itty-Bitty radio Telescope or IBT. This is a more difficult project because it involves building the IBT. There is a detailed building plan available from the National Radio Astronomy Observatory (NRAO) (http://www.aoc.nrao.edu/epo/teachers/ittybitty/procedure.html) that will help you with this task.

This is a project I will discuss in more detail in a future article but is fairly easy to make. If you decide to try the project, follow the directions and if you need help you can contact your local ham radio group. There is also an IBT group on the SARA website where you can get some assistance. By pointing the IBT at the Sun you will be able to read the voltage from the device which is directly related to the radio energy striking the dish antenna from the Sun. Once again it must point directly at the Sun the whole time you observe.

As the Sun is blocked, the radiation will drop and you can record this change. If you have access to a digital voltage recorder, that would even be easier. After you record the voltage change every minute or so, make a graph and review your results.

Heat from the Sun

When students think about heat they think about thermometers and that's exactly what we're going to use. You simply monitor the temperature before, during, and after the eclipse. You can do this by reading a thermometer every few minutes or, more easily with a digital thermometer that records the data to computer. As mentioned before, many of these are available, including my favorite from Vernier Software. After the eclipse, plot the graph and you should see some change in the temperature. I haven't tried this (I haven't been near enough to an eclipse to measure temperature changes), but I know people who have done it and have recorded surprising changes.

The Sun's Effects on the Earth Environment

Lastly, the Sun affects our Earth environment and radio signals near us. Many low frequency radio sources use the Ionosphere to either bounce or direct the waves toward receivers. This layer of the atmosphere is in part generated by the radiation from the Sun and is re-formed daily at sunrise and dismantled, in part or totally, at sunset. Thus, when the eclipse happens there should be a change in the Ionosphere that we can detect. To observe this, we need a radio that can detect the signals I discussed. There are several detectors you could use:

SuperSID: The SuperSID radio, which was designed by Stanford Solar Center and is distributed by SARA, detects low frequency radio signals from the Navy Submarine communications stations and monitors their intensity. This intensity varies with changes in the Ionosphere caused by solar flares and other storms as well as lightning. Check out the website for more information: http://www.radio-astronomy.org/node/142 (top of the page) or the Stanford Solar site: http://solar-center.stanford.edu/SID/sidmonitor/. You will need to run the SuperSID radio for several days to see what a 'normal' chart looks like and then compare it to the chart you record on the eclipse day. There should be a measurable difference in the two associated with the changes in the Ionosphere when the eclipse occurs. Although the main detector is assembled for you, there is some fairly simple building and assembly required. This includes wrapping wire around a wooden frame for an antenna and hooking up the wires to the device and a computer sound card as well as installing a software package to run the device.

The team for SuperSID is very helpful and can help you or you can once again contact a local ham operator and ask for help. Hundreds of these radio telescopes have been built and are used throughout the world to monitor the Sun's activity on a daily basis. This device will be discussed in more detail in my next article.

Ham Radio: Contact a local ham radio operator and see if they will allow you to record the signal for a station that is far away and would rely on the Ionosphere for signal reception. This might include AM radio, HF band radio signals in the Low MHz range and certainly the VLF and LF signals you can detect using the SuperSID discussed above. This is also a way to get someone involved with your class who might trigger interest in radio projects. I've found that ham radio operators are very willing to share and come into a classroom and assist with projects, so I recommend trying to contact someone in your area. If you can't find anyone, contact the American Radio Relay League (ARRL), as they have many members worldwide.

One Final Note: If you can't afford to do any project including visual observation you can still observe the eclipse in a spectacular way. Simply go outside just before the eclipse and have students find shadows from a tree with leaves on the ground. Watch the shadow as the eclipse occurs, perhaps coming out every 10-15 minutes and checking them out. They will be able to clearly see the eclipse in the shadows. The leaves act as a lens and focus the eclipse on the ground. Though the images are small, I found them quite impressive the first time I saw it!

I hope you will take advantage of this rare event and observe the eclipse – it is a great chance to teach about the Sun, solar energy, radiation, planetary motion, etc.