

**Project SunSHINE**  
Students Help Investigate Nature in Eastchester

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**Overview:**

The eighth graders of Eastchester Middle School are presently embarking on the second year of conducting an interdisciplinary solar research investigation in partnership with Project SUN, NASA's Mission To Earth program, and the International Science Network using resources of The Use of Astronomy In Research Based Science Education program sponsored by the National Optical Astronomy Observatories. Throughout the 1998-2000 school years, over 350 eighth graders have participated in some aspect of Project SunSHINE. In various classes, the students are divided into teams for the purpose of gathering data, making hypotheses, interpreting data, and reporting the findings.

**Objectives:**

This multi-year research project is attempting to answer these specific scientific questions:

1. How do visible and ultraviolet light levels in this location vary throughout the school year?
2. How do visible and ultraviolet light levels correlate to daily weather conditions, if at all?
3. How do visible and ultraviolet light levels correlate to sunspot activity, if at all?

Along with the above stated questions SunSHINE is striving to change /enhance students perceptions regarding the following affective skills:

1. Students will become aware of how long-term scientific research is conducted using a multi-level team approach.
2. Students will realize it is in their best interest to be aware of the interrelationship of ultraviolet energy and how it effects them on a local scale
3. Students will have a new understanding of how information can be shared through a wide variety of mediums.

**Ultraviolet & Visible Light:**

Student teams in the computer technology classes measure and record the levels of ultraviolet (UV) and visible light daily. Two sensors, mounted on

roofing, are interfaced to a Macintosh computer. The visible light and UV sensors make independent measurements throughout a predetermined length of time. These readings are displayed and graphed on the computer monitor. The Sensor Activation Team "turns on" the sensors from the computer at precisely 8:15 AM. After six hours, both datasets are stored as text files for later analysis and transmission to the Jet Propulsion Laboratory. The hardware system being used to collect the local solar data consists of a solar radiation sensor and a UV sensor made by Davis Instruments connected to a Macintosh computer using a Vernier Serial Box Interface.

### **Weather Reporting:**

At 8:15 AM and 1:15 PM each day, a Weather Team records measurements in the log book. A weather station located on the roof of the school measures the temperature and barometric air pressure. For current measurements of humidity, wind speed and direction, students access local weather readings from the Yahoo! Weather website. The internet is used to provide measurements not available from the school weather station.

### **Counting Sunspots:**

Sunspots are visible areas of relative darkness on the sun's surface, the photosphere, caused by very strong magnetic fields. Small spots, measuring about 220 km, may exist for less than one hour while spots 75,000 km across can remain for six months. The quantity of sunspots varies over a predictable, eleven-year cycle, as does other solar activities such as the level of ultraviolet emission. One measure of the changing sunspot cycle is the "sunspot number," calculated to be ten times the number of sunspot groups added to the number of individual sunspots observed.

As of 1998, the sun entered a period of increased sunspot activity. Project SunSHINE will determine if the local levels of ultraviolet are affected by maximum solar activity. Our student researchers are using the sunspot number as one indicator of changes in the solar cycle. Although sunspots can be observed with small, solar observing telescopes, an accurate count of the day's sunspot number could not be made with these instruments. Therefore, the Sunspot Number Team relies upon the web for this information. The daily sunspot number is published on the website entitled Sunspots and the Solar Cycle (<http://www.sunspotcycle.com/>).

### **Calculating Sunspot Areas:**

Although the sunspot number is an indicator of solar activity, it does not take into account the various sizes of sunspots. Their diameters range from hundreds to tens of thousands of miles, greater than that of Earth. Therefore, the total area of all observable sunspots is calculated every day as a second measure of solar activity.

The Sunspot Area Team must download a solar image from the internet daily, and then use specialized software to calculate the area of the observable sunspots. The Kitt Peak Vacuum Telescope (National Solar Observatory) publishes the latest solar images on the

web at <http://www.nso.noao.edu/synoptic/synoptic.html>. The students use the "intensity" image to determine sunspot areas.

### **Reporting The Findings:**

The scientific findings of Project SunSHINE are being e-mailed weekly to NASA's Jet Propulsion Laboratory and are published on their website (<http://sunshine.jpl.nasa.gov/>). Project SUN, NASA's Mission To Earth program, is determining how local visible light and ultraviolet levels vary geographically. The solar data being studied is submitted by participating schools worldwide.

Dr. Gil Yanow, at the Jet Propulsion Laboratory (JPL), is compiling and analyzing similar reports received from Europe, Asia and the Americas over three years. For in-school use the data is organized into an excel dataset that the school's network system. Teachers and students can access this information at anytime.

The computer technology classes are writing a solar handbook to provide background information about the sun and solar radiation. This guide will be published on the school's website this Fall.

The datasets and their statistical analyses are being used by the science classes to hypothesize if weather variations, changing seasons, and sunspot activity have any measurable effect on average levels of solar radiation. Throughout the school year, students are attempting to interpret the data and statistics, modifying their hypotheses as necessary. Their findings are published on the Project SunSHINE website: <http://www.westnet.com/~rickd/>.

### **Exciting Findings:**

Based upon the first year of data, students have developed some working conclusions. These preliminary conclusions were written in abstract form and shared with Dr. Yanow of JPL. He was very excited to see data that supported an inverse relationship between relative humidity and ultraviolet levels. Less surprising was the inverse relationship of visible light and relative humidity. Many of the other variables, such as ultraviolet level, sunspots or cloud types, will need a larger dataset to determine if there is any type of relationship.

### **SunSHINE Future:**

In May 1999, The Journal News Golden Apple Awards named Project SunSHINE the 1999 New York Wired Applied Technology Award winner. The award consisted of a \$20,000 grant for the acquisition of additional equipment to enhance the existing research program. SunSHINE is purchasing an AirWatch Weather Station, a state-of-the-art digital instrument for the collection of local weather data. The station will make continuous measurements of temperature, air pressure, humidity, wind speed and direction, while displaying these values in real time on a dedicated website. The team is

also buying a Celestron Celestra 8 inch Schmidt-Cassegrain telescope with a full-aperture glass solar filter so students can make live sunspot observations. This will enable SunSHINE to move to the next level of research.

**Conclusion:**

The first complete year of Project SunSHINE has been a truly rewarding experience. The students have gained a new respect for the Sun's energy and teamwork in long-term scientific research. From a teacher point-of-view, it has been a splendid endeavor that is allowing our students to conduct true research that is unheard of at the Middle School level. The truly interdisciplinary nature of SunSHINE requires a tremendous amount of work but it has been well worth the effort.

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This program has been totally self-funded with grants received from the BEPT Teacher Center, Impact II of Westchester/Rockland BOCES, New York State Model School Program, Reader's Digest Foundation Interdisciplinary Learning Project, New York State Lotto and the New York Journal New

Useful internet sites:

Project SUNSHINE <http://members.aol.com/mrdonahue2/sunshine/sunshine0.html>

Eastchester Middle School <http://www.westnet.com/~rickd/>

Sunspots- NASA <http://www.sunspotcycle.com/>

Project SUN <http://sunshine.jpl.nasa.gov/>

The Use of Astronomy <http://www.noao.edu/noao.html>  
Science Education

AirWatch Weather System <http://www.aws.com/>

Kitt Peak Vacuum Telescope <http://www.nso.noao.edu/synoptic/synoptic.html>  
latest solar images