

# THE 2024 TOTAL SOLAR ECLIPSE AS A DRIVER FOR ENGAGEMENT AND RESEARCH COLLABORATION BETWEEN HIGH SCHOOL AND COLLEGE STUDENTS

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## Abstract

The total solar eclipse of 8 April 2024 tracked across the central and eastern United States, creating an opportunity for millions of people to see this remarkable phenomenon. It also provided a shared experiential learning opportunity for students of all ages. This poster reports on a collaborative effort between undergraduate students at Bucknell University and high school students at The Greenhill School. Both groups of students worked together to design and execute an “astronomy fair” on the day of the eclipse for the Greenhill community. This fair comprised hands-on stations and in-person presentations describing the scale and geometry of the Earth, Moon, and Sun, and the precise alignment required for a total eclipse. Both groups also worked together to design and enable research experiments involving observations of the Sun’s inner corona (which can only be done during an eclipse). The educational and scientific components of the program were quite successful, based on the feedback of the ~1500 K-12 participants and the scientific data acquired. Perhaps even more importantly, the student organizers (both high school and undergraduate) deeply valued the opportunity to develop and lead the program collaboratively. As a result of this experience, several indicated interest in pursuing physical science or science education as careers.

*Keywords: Science and technology education, secondary education, higher education.*

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## 1. Introduction

Total solar eclipses leave an indelible mark on those fortunate enough to see one. These people can vividly recall many details of the event many years, and even decades, after it occurred (Sang, 1999). For a few brief moments when the moon blocks the bright central region of the Sun (the photosphere), the sky darkens markedly and reveals the Sun’s looping filamentary outer veil called the corona. Invisible under normal circumstances, the corona is visible during eclipse extends across the sky in a display that is many times the size of the eclipsed Sun. Solar eclipses are relatively common, occurring on average every year or so. However, the total eclipse phase can only be viewed from a narrow strip of the Earth’s surface -- the “Path of Totality” -- which is typically only a few tens of km wide. Moreover, at any point within this path, totality occurs for at most a few minutes, and can be observed only if weather conditions permit. Thus, only a small fraction of the world’s population has direct experience with this phenomenon.

Two recent eclipses have garnered substantial attention because their paths of totality stretched across highly populated regions of North America. The path of the 2017 eclipse passed from the U.S. state of Oregon across the United States to South Carolina, and the 2024 total solar eclipse path stretched from Mexico thorough the central United States and into Canada. Because of mostly cooperative weather several tens of millions of people observed totality during each of these events. These events provided opportunities for people to see this phenomenon; however, it is not clear that these observers fully understood the circumstances and geometry required for this view. In research published before these eclipses, Kanli (2015) found that many high school and undergraduate students, as well as their teachers, could not reliably describe the geometry necessary for a total solar eclipse. Thus it was clear that these two eclipses provided opportunities to help address broadly-held misconceptions regarding the geometry of the local astronomical environment.

## 2. The eclipse research and education project

A group of students and faculty from Bucknell University in Lewisburg, Pennsylvania constructed a plan to observe the 8 April 2024 total solar eclipse, with the twin goals of astronomical research and

public science education. The research component would involve detailed observations of the Sun's chromosphere and inner corona, regions of the solar atmosphere that can be most easily observed during totality. Plans were made to construct a research field station comprising several portable telescopes and cameras for data acquisition. An outreach component was envisaged to include presentations and hands-on demonstrations available to the public just prior to totality, so as to provide context for the phenomenon they were about to observe. However, since the Lewisburg campus of Bucknell University was not in the path of totality, a better-positioned site was required for this project.

A site within the path of totality was found via a collaboration with the Greenhill School in Addison, Texas. The K-12 private school agreed to provide a site for the field research station, as well as power and support facilities. While the collaboration originally revolved around logistical issues, it evolved into collaborative efforts in programming and outreach. Interested high school students were paired with Bucknell undergraduates, and together these teams worked on both the research and educational projects. Teams met via Zoom in the months before the eclipse, and then worked together on the ground in the critical few days prior to eclipse day.

### 3. Eclipse day events

Education and outreach activities on eclipse day were organized into an "Astronomy Fair" for the student population of the Greenhill School in grades 5-12. Approximately 1000 students moved among nine stations throughout the time before totality. At each station, students engaged with concepts related to the eclipse. Station activities included observing the partially-eclipsed Sun with a projection telescope, a craft showing the relative motions of the Sun, Moon, and Earth, and the construction of a planet walk illustrating the relative distances between the solar system's planets. Students carried with them a passport, and for each completed activity, they received a passport sticker.

*Figure 1. Students compare the size of the Sun with the size of planets and the Moon.*



*Figure 2. A student shows off her Eclipse Day passport with stickers that show she has completed four stations.*



Students were also able to interact with Bucknell students taking data at the field research station. Observations focused on measurements of the spatial structure of the inner corona, and the time-variability of coronal emissions, two types of measurements that are difficult to conduct except during totality. This station was set up centrally on the Greenhill School campus, so that Greenhill students could interact with

the students conducting the science research. Before and after totality, Bucknell students were able to answer questions and describe their research projects to interested students.

Figure 3. Students at the on-campus field research station conducted experiments to measure the structure and time variability of the Sun's corona. Note that many parts of the equipment have labels describing their function.



#### 4. Reflections on the eclipse education experience

Many days after the eclipse, Bucknell students reflected on their experience as participants and curators of the eclipse experience. Students commented on the sense of awe they felt during the brief moments of totality, and they also took great value from their roles as science educators. Three students captured the importance of their combined roles in the following excerpts:

- “Seeing the reactions of those around me made me realize that providing the students with some educational background about the event makes it even more awe-inspiring. Understanding how exactly the geometries of the sun and moon interact to create a thin path of totality along the Earth, coupled with the knowledge of the vast scales at play, creates a profound appreciation for the event, something that is lost on those ignorant to the background of the topic.”
- “one can study a phenomenon their whole life and understand it in every minute detail, but if one has never observed the phenomenon can they really say they ‘know’ it? For younger students, such as the Greenhill students, this kind of experience can be incredibly inspirational and help them find a passion that they might want to pursue.”
- “In retrospect, it wasn't just the celestial spectacle of totality that made our trip unforgettable; it was the collective anticipation, the shared moments of discovery, and the lasting impact on those around us that truly made it special.”

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