

Motivation, public health improvement, develop friendly relations among nations, and promotion of science through teaching astronomy and variable star observation by AAVSO and volunteers

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Abstract

Peace, happiness, and life expectancy are the characteristics of a healthy society. Any life pressure, loneliness, financial problems, depression, and despair can lead to quick and dangerous decisions with very high financial and social costs, both for the individuals and for society. Meanwhile, children, the elderly, the poor, and people with social problems or severe diseases such as cancer are more vulnerable psychologically. At the same time, there are always plenty of talented students in schools and universities who welcome an interesting scientific idea for activity and research as excellent volunteers. During ten years of volunteer teaching basic astronomy concepts with night sky observation sessions publicly in various places including schools, universities, hospitals, rehabilitation centers, and parks, these programs have always been very well received by the audience, and this is a cost-effective care strategy that brings more positive energy into life. People, including patients and the elderly, usually report positive emotions, and higher life expectancy, as well as increasing desire to continue treatment and recovery along with a significant reduction in treatment costs. Usually about five to ten percent of these people will be interested in more advanced levels and more serious activities. The next step is to introduce the AAVSO, and let them know about the variable star observation, and its attractive scientific applications by volunteers as ambassadors for the AAVSO. Observing the night sky is relaxing. Cooperation and community of variable star observers from different countries also develops friendly relations among nations.

1. Introduction

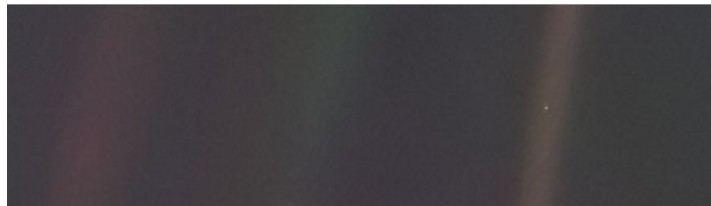


Image 1. The Pale Blue Dot is a photograph of Earth taken Feb. 14, 1990, by NASA's Voyager 1 at a distance of 3.7 billion miles (6 billion kilometers) from the Sun (image credit: NASA)

"From this distant vantage point, the Earth might not seem of any particular interest. But for us, it's different. Consider again at that dot. That's here. That's home. That's us."
- Carl Sagan [1]

A little above the ground, no border between cities and countries can be seen from the sky. It seems the Earth is a sphere with a unified civilization on it. From space, Earth is a Pale Blue Dot (Image 1).

Variable star observers from different countries around the world are working with great coordination and cooperation to collect and record scientific data in an integrated system that is created by the AAVSO. Variable star observation is a serious scientific activity by international volunteers, written in the language of peace and love that develops unity and friendly relations among nations.

2. Why astronomy and variable star observation?

Of all types of motivational activities, night sky observation and astronomy are among the most attractive and influential for all ages. Basic concepts of astronomy are very attractive and easy to learn. Topics include observing the beauty of the night sky, constellations, the solar system, lunar phases, tides, solar eclipses, lunar eclipses, what causes days and nights, what causes Earth's seasons, evidence that the Earth is round, planet Earth, other planets, the stars, nebulae, galaxies, comets, and meteors, are very interesting for all people.

Serious and purposeful people are attracted to serious and purposeful activities. Because a small portion of people want to know more about astronomy, variable star observation is suggested as a good choice because interested people can easily learn and make genuine contributions to scientific research and discovery.

3. What is variable star and variable star observation?

"A variable star is a star whose brightness as seen from Earth (its apparent magnitude) changes with time. This variation may be caused by a change in emitted light or by something partly blocking the light, so variable stars are classified as either:

1. Intrinsic variables, whose luminosity actually changes; for example, because the star periodically swells and shrinks.
2. Extrinsic variables, whose apparent changes in brightness are due to changes in the amount of their light that can reach Earth; for example, because the star has an orbiting companion that sometimes eclipses it." (From Wikipedia, [2])

"The most common kinds of variability involve changes in brightness, but other types of variability also occur, in particular changes in the spectrum. By combining light curve data with observed spectral changes, astronomers are often able to explain why a particular star is variable. Variable stars are generally analysed using photometry, spectrophotometry and spectroscopy. Measurements of their changes in brightness can be plotted to produce light curves. For regular variables, the period of variation and its amplitude can be very well established. Amateur astronomers can do useful scientific study of variable stars by visually comparing the star with other stars within the same telescopic field of view of which the magnitudes are known and constant. By estimating the variable's magnitude and noting the time of observation a visual light curve can be constructed. The American Association of Variable Star Observers (AAVSO) collects such observations from participants around the world and shares the data with the scientific community." (From Wikipedia, [3])

4. About AAVSO

Since its founding in 1911, the American Association of Variable Star Observers (AAVSO) has coordinated, collected, evaluated, analyzed, published, and archived variable star observations made largely by amateur astronomers and makes the records available to professional astronomers, researchers, and educators. These records establish light curves depicting the variation in brightness of a star over time.



Image 2. AAVSO logo (image credit: <https://www.aavso.org>)

Since professional astronomers do not have the time or the resources to monitor every variable star, astronomy is one of the few sciences where amateurs can make genuine contributions to scientific research. During 2011, the 100th year of the AAVSO's existence, the 20-millionth variable star observation was received into the database. The AAVSO International Database (AID) stores over 35 million observations as of 2019. The organization receives nearly 1,000,000 observations annually from around 2,000 professional and amateur observers and is quoted regularly in scientific journals. The AAVSO is also very active in education and public outreach. They routinely hold training workshops for citizen science and publish papers with amateurs as coauthors. [4]

The mission of the AAVSO is to enable anyone, anywhere, to participate in scientific discovery through variable star astronomy. [5] After more than a century of successful activity, the AAVSO has developed multilingual educational facilities and content for teaching variable star observation and its data registration; and if they wish and receive enough support, they can lead and manage volunteers for general teaching of astronomy from basic concepts to variable star observation.

The participation and cooperation of scientists and observers from all over the world in the AAVSO and their communication and sharing in the AAVSO's forum and events provide a great opportunity, not only for the development of science and discovery, but also to develop friendly relations among nations.

5. Applications of variable star observation

"Research on variable stars is important because it provides information about stellar properties, such as mass, radius, luminosity, temperature, internal and external structure, composition, and evolution. Some of this information would be difficult or impossible to obtain any other way." (From AAVSO web site, [6])

6. Other applications of variable star observation

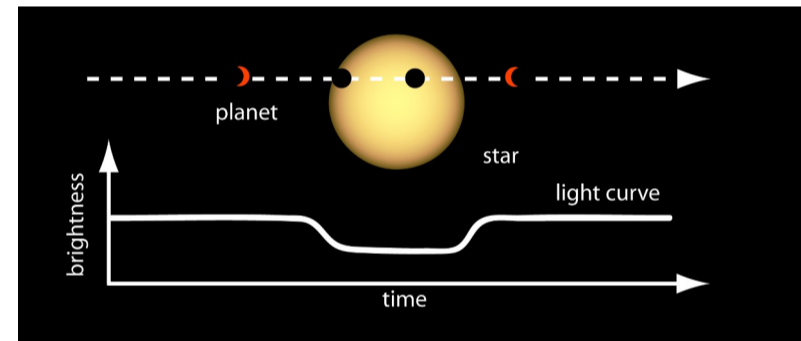


Image 3. Light Curve of a Planet Transiting Its Star (image credit: NASA- Kepler and K2)

"Stars with planets may also show brightness variations if their planets pass between Earth and the star. These variations are much smaller than those seen with stellar companions and are only detectable with extremely accurate observations. Examples include HD 209458 and GSC 02652-01324, and all of the planets and planet candidates detected by the Kepler Mission." (From Wikipedia, [7])

"Transit data are rich with information. By measuring the depth of the dip in brightness and knowing the size of the star, scientists can determine the size or radius of the planet. The orbital period of the planet can be determined by measuring the elapsed time between transits. Once the orbital period is known, Kepler's Third Law of Planetary Motion can be applied to determine the average distance of the planet from its stars." (From NASA Kepler web site, [8]) In addition to the application of variable star observation in the discovery of exoplanets, variable star observers also have the chance to discover phenomena such as new supernovae and comets.

7. Science promotion and public health improvement

7.1. For children

Night sky observation is very amazing for children, especially telescopic observation of the moon, Jupiter, and Saturn. Children are always eager to learn. Learning basic concepts of astronomy helps them to plan for the future, and to have an even better understanding of school subjects and their applications, especially mathematics, physics, chemistry and biology. They may even become interested in variable star observation. In the future, maybe they will decide to study astrophysics, or astrochemistry, or astrobiology in university, or maybe they will choose computer programming, or professional photography and astrophotography as a job, or maybe they will choose something completely different. The truth is that astronomy would be a basis for their familiarity with different sciences and professions, and they will have more opportunities for innovation and creativity.

7.2. For young people

Whether at home, school, university, hospital, rehabilitation center or even in prison, young people either have a lot of free time or they are very busy because they are surrounded by different ideas and plans. In any case, observing the night sky and astronomy is attractive and relaxing for them, and if they get interested in variable star observation, they can be serious and reliable observers and even eager and productive volunteers.

7.3. For the elderly

Having free time and a great desire to feel useful in society is one of the characteristics of most elderly people. Elderly people in hospitals and rehabilitation centers usually have more free time and enthusiasm to do fun and useful things, especially if these activities have a scientific and humanitarian aspect.

After learning basic concepts of astronomy and observing the beauty of the night sky, they usually request question-and-answer sessions. Those interested in more advanced levels are good candidates to learn and to start observing variable stars.

7.4. In schools and universities

Schools and universities are the best places to attract serious volunteers, both for holding night sky observation sessions and for teaching astronomy, and as variable star observers. This is a good opportunity for current students and future scientists to improve their social, communication and teamwork skills as well as research, innovation, and creativity.

7.5. In hospitals and rehabilitation centers

Feeling alone, being forgotten or abandoned, illness, despair and depression – This is what most people in hospitals and rehabilitation centers experience more or less. They also have a lot of free time along with a strong desire to feel useful in society.

In addition to many problems for patients with cancer and severe diseases, such as suffering from disease and the high costs of access to appropriate treatment and medicine, which puts pressure on patients and their families, sometimes patients are not able to attend classes in the classroom. Therefore, serious concern about their future and fate after recovery is also formed in their minds.

Participating in night sky observation sessions and learning basic concepts of astronomy, even once, can increase positive emotions and helps patients to use their free time for study and useful scientific activities instead of focusing only on their illness. Moreover, those interested in more advanced levels are good candidates to learn and to start observing variable stars to enjoy its benefits for a long time. These benefits can be associated with more positive energy, reducing death anxiety and increasing happiness, improving quality of life, and more willingness to continue treatment, thereby reducing duration of treatment for patients, less need for medication, and reducing costs.

7.6. Insurance for insurers (and a proposal for a case study)

Any plan related to reduction in healthcare costs is associated with greater profitability for insurance companies. Every dollar they pay to sponsor these plans can save them more dollars in the future.

As mentioned in Section 7.5, participating in night sky observation sessions and learning basic concepts of astronomy, even once, can increase positive emotions and decrease healthcare costs. But by how much? Let's propose a case study. For example, let's consider Kaiser Permanente.

Kaiser Permanente, commonly known as Kaiser, is an American integrated managed care consortium, based in Oakland, California, United States, founded in 1945. Kaiser Permanente is one of the largest non-profit healthcare plans in the United States, with over 12 million members. It operates 39 hospitals and more than 700 medical offices, with over 300,000 personnel, including more than 87,000 physicians and nurses. [9]

In one of their hospitals, it is possible to hold sessions on observing the beauty of the night sky, teaching the basic concepts of astronomy, and then variable star observation for interested patients, by volunteers. The positive results can be collected, investigated, and compared with other hospitals. Even patients with cancer or cardiovascular diseases can be good candidates to participate and enjoy the benefits of this plan.

7.7. Wall Street

In the case of companies, employees, and their families, they could also participate in teaching sessions by volunteers on the basic concepts of astronomy and observing the beauty of the night sky. As a suggestion, it could be considered as a paid service based on mutual benefits. This would be a low-cost hobby for company employees with a lot of benefits for themselves and their families and would also provide a small amount of financial support for volunteers

8. Science Promotion and Developing Friendly Relations among Nations

8.1. United Nations



Image 4. Flag of the United Nations (image credit: <https://www.un.org>)

The United Nations (UN) is an intergovernmental organization whose stated purposes are to maintain international peace and security, develop friendly relations among nations, achieve international co-operation, and be a center for harmonizing the actions of nations. [10]

The United Nations Economic and Social Council (ECOSOC) is one of the six principal organs of the United Nations, responsible for coordinating the economic and social fields of the organization. Over 1,600 nongovernmental organizations have consultative status with the Council to participate in the work of the United Nations. [11]

The AAVSO could have consultative status with the Council to participate in the work of the United Nations too, because both have one role in common: to develop friendly relations among nations.

Variable star observation inspires people in peacekeeping and motivates them to international cooperation in promoting science for people of all colors, races, and nationalities.

8.2. UNESCO



Image 5. UNESCO logo (image credit: <https://www.unesco.org>)

"The United Nations Educational, Scientific and Cultural Organization (UNESCO) is a specialised agency of the United Nations (UN) aimed at promoting world peace and security through international cooperation in education, arts, sciences, and culture. UNESCO's founding mission is to advance peace, sustainable development, and human rights by facilitating collaboration and dialogue among nations. It pursues this objective through five major programme areas: education, natural sciences, social/human sciences, culture, and communication/information. UNESCO sponsors projects that improve literacy, provide technical training and education, advance science, protect independent media and press freedom, preserve regional and cultural history, and promote cultural diversity." (From Wikipedia, [12])

Natural science can be divided into two main branches: life science and physical science. physical science is subdivided into branches: physics, chemistry, Earth science, and astronomy. [13]

AAVSO and UNESCO can cooperate in many fields. UNESCO can also sponsor variable star observation and AAVSO projects.

9. Conclusions

Over the years, the following experimental results have been observed during volunteer holding night sky observation and astronomy teaching sessions in various places such as schools, universities, hospitals, rehabilitation centers and even on the streets for people of all ages:

1. Participating in the night sky observation sessions and learning basic concepts of astronomy, even once, can increase positive emotions, life expectancy, and getting away from sadness.
2. Observing the night sky and astronomy is relaxing and humbling. It is associated with the development of peace and friendship too.
3. Knowing that the universe is so vast and that we are made of stardust comes with a sense of greatness.
4. Understanding the fact that everything in the world has a limited life is associated with a decrease in death anxiety and an increase in happiness.
5. Getting to know that space is a very harsh and dangerous environment for life is inspiring people to resist and bear the hardships of life.
6. At any level, a cell, human body or the planet Earth, life is a complicated phenomenon and understanding it motivates people to appreciate the value of life better.
7. Observing the beauty of the night sky even once (especially using a telescope or binoculars), or variable star observation as a continuous activity, is so relaxing that can be associated with reducing the need to use of sedatives, painkillers and sleeping pills in some people and can reduce the cost of treatment and healthcare. In the case of some elderly, cardiovascular and cancer patients who often have a history of sadness or depression, it may be associated with a decrease in mortality. Note that these are not general rules. Measuring and providing more detailed information requires specialized research.
8. The participation and cooperation of scientists and observers from all over the world in the AAVSO and their communication and sharing in the AAVSO's forum and events is a great opportunity, not only for the development of science and discovery but also to develop friendly relations among nations.

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Appendix: About the Author [14]