

Time, Technology and Telescopes

Teacher Background

Current scientific knowledge has only developed through many centuries of effort, and through the contributions of many people, from many cultures and countries. Some discoveries, such as the discovery of emission lines in the solar spectrum, have been made accidentally during the quest for other knowledge. Some emerged from the patient accumulation of data over decades, followed by a new awareness of a previously unrecognized pattern, such as the “Butterfly diagram” depicting sunspot positions over a solar cycle. Our present understanding of the Sun demonstrates both phenomena well, and science education today focuses on the history and process of discovery and invention, along with essential scientific principles.

LIVE FROM THE SUN provides an excellent opportunity to incorporate this approach. Humans have been fascinated by the Sun from our earliest civilizations. Galileo observed sunspots in the early 1600s through the simplest of telescopes, but Chinese observers saw them more than 1,700 years earlier. Scientists have been studying the Sun for hundreds of years, but even today we have not solved all of the mysteries about exactly “How the Sun Works”. We now observe the Sun through an international fleet of spacecraft working in conjunction with ground-based observatories all around our planet. Soon, perhaps, what we today consider to be advanced technology will appear as simple as Galileo's first telescope. It's important that students develop an appreciation not only for science, but also for the people who have contributed to its exciting history.

Objectives

Students will research how people of different cultures and times have contributed to our knowledge about the Sun and develop a text and image timeline of solar discoveries.

Students will research and report how the instruments we use today are similar to or different from those of the past.

Materials

Suggested URLs, for students

reference materials in print and/or online: textbooks, CD-ROMs, Internet

markers, paper or adding machine tape (and other materials for poster presentations)

Engage

Discuss how we observe the Sun today. Use sections from the Teacher Resource Video or the LFSUN programs. Go online to review the various research centers engaged in solar studies, e.g. NASA Goddard Space Flight Center, Kitt Peak, Lockheed Martin, and more, and read some of the *Biographies* and *Field Journals* posted there. What tools do researchers use today? What did scientists use in the past? Are the instruments we use today completely new or simply improvements of those used in the past? Use a few of the dates and events to be found in the Sample Timeline to seed student awareness of events in the more distant past. Review some key discoveries in the 20th Century. What are the advantages of using spacecraft in comparison to terrestrial observatories? The disadvantages? (Cost, difficulty to reach and repair, etc.) And vice versa. Review the necessity for spacecraft, balloons or rockets to observe certain wavelengths of light. (Turbulence in the lower layers of the atmosphere causes light to be distorted resulting in the “twinkling” of starlight. Weather conditions, smog and atmospheric haze can obscure the view.)

Explore/Explain

Divide the class into teams. Each team is responsible for researching and presenting a section of the Timeline. You may wish to let them to debate and decide how “section” is defined. It could be by century (in which case those who work on the 20th C. will be VERY busy, and those who get the 2nd-9th. can go on vacation!) or by type of instrument (telescope, spacecraft, etc.) or by continent, or culture. Once decided, have students use the Internet, print resources and CD-ROMs to research their section, and make the actual timeline. Go online and share your class choice with other educators.

Explain to the students that they are going to present their research to the entire class in an oral presentation, supported by visuals. The actual chronology (or backbone) of the timeline can be displayed on adding machine tape or sheets of construction paper.

Provide students with some key topics which all presentations must address. Brainstorm with the whole class about what additional areas might be added:

Required content:

Who studied the Sun during this time period? (e.g. priests, astrologers, astronomers, satellite engineers)

What new discoveries were made about the Sun during this period?

Were these discoveries readily accepted at that time?

What instruments were used to study the Sun? (Stonehenge, to spacecraft and telescopes)

Were these instruments new or were they developed from instruments of the past?

Were other scientists from different parts of the world making similar discoveries at the same time?

Encourage students to research and include pictures of the scientists and the instruments of their time period. Have students use their SUNlogs as a place to make notes and collect information before creating their presentation materials.

Take still or digital photos of student work, and share with PTK via the LFSUN website.

Some students may choose to make a replica of Galileo’s first telescope, others those used in the 19th and 20th centuries to study the Sun, basing them on pictures they find during the course of their research.

REPEAT OUR WARNING FROM EARLIER ACTIVITIES ABOUT NEVER LOOKING DIRECTLY AT THE SUN, ESPECIALLY THROUGH ANY TELESCOPE OR BINOCULARS!

Use the Timeline as a component of parents’ night or a *SUN*Expo* wrapping up this unit.

Add a speculative section for the coming decades. Based on what they hear or read scientists saying about what we still don’t fully understand, what discoveries might we expect? (Use the ISTP website, below, for information about future missions.)

Suggested URLs

(this has been provided, with additional references, as a Blackline Master to provide students with a research guide.)

http://www.hao.ucar.edu/public/education/sp/great_moments.html#gm_1610

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http://www.hao.ucar.edu/public/education/sp/great_moments.2.html#gm_1645

Great Moments in the History of Solar Physics chronicles developments and discoveries through 1860. Includes drawings from early scientists and links to additional information.

<http://seds.lpl.arizona.edu/billa/psc/hist1.html>

Traces history of major astronomers, instruments and discoveries from 1500 BC to 1811.

<http://www-istp.gsfc.nasa.gov/istp/outreach/future.html>

International Solar-Terrestrial Physics (ISTP): explains future ISTP missions.