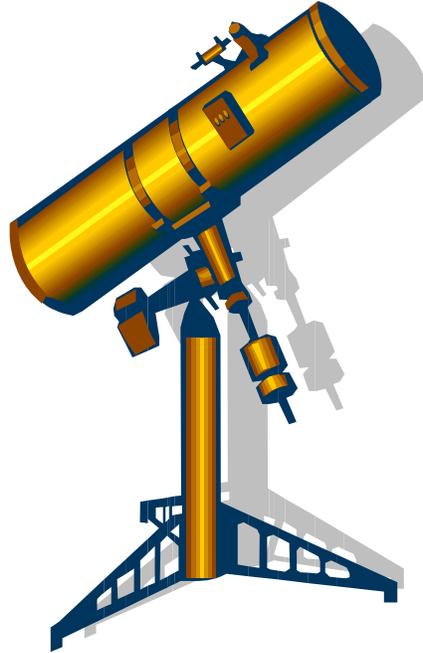


Teacher Idea Kit



TWO SMALL PIECES OF GLASS
**A Space Science Program for
Grades 5-12**

Presented by

ABBITT
PLANETARIUM



Funded in part by:



Two Small Pieces of Glass

Suggested for Grades 5-12

Objectives

After visiting the planetarium for Two Small Pieces of Glass, the student should be able to:

1. Discuss the contributions of Galileo Galilei and the telescope to modern astronomy.
2. Discuss the optical structure and design of traditional and modern telescopes.
3. Identify the various wavelengths of light and discuss how they are used in astronomy.

State Standards of Learning Objectives

This planetarium presentation meets the following Virginia State SOLs:

Science: 5.3, 6.8, PS.9, ES.3

Vocabulary

adaptive optics:	A process used in modern telescopes by which the main collecting mirrors of the telescopes are manipulated so as to eliminate the effect of the shifting atmosphere of the Earth on the images produced by the telescope.
astronomer:	A person who studies the sky as seen from Earth by means of various instruments, including, but not limited to, the human eye.
electromagnetic spectrum:	The name given to the range of light energy seen in the universe. The electromagnetic spectrum consists of, in order of increasing energy: radio, microwave, infrared, visible ultraviolet, x-ray, and gamma-ray energy. All of these types of energy are used in astronomy.
Galileo Galilei:	An Italian astronomer and physicist (1564-1642) who counts among his numerous achievements being the first man to use a telescope to view the heavens.
lens:	A piece of glass or plastic shaped in such a way as to manipulate light rays, bring them into focus or creating a magnifying effect. Lenses are commonly used in telescopes, both for gathering light and for focusing it.
mirror:	A piece of glass, ground, shaped and silvered in such a way as to reflect light rays in a desired fashion. Mirrors are commonly used in modern telescopes to collect light.
optical telescope:	A name used for telescopes which use visible light. These telescopes are most commonly located on the surface of the Earth, and produce images only in the wavelengths of light which the human eye is capable of seeing.
radio telescope:	A name used for telescopes which use large receiving dishes to gather and focus radio waves to produce images of objects in space. Such image are then color-coded to make them useful to astronomers.

space telescope: A name used for telescopes launched from the Earth and placed in space. Such telescopes generally observe objects in more than one type of light, allowing astronomers to gather more information about the objects they study.

telescope: A device used for magnifying the view of objects, primarily those seen in the sky.

Background Material for Two Small Pieces of Glass

The invention of the telescope marked a major turning point in man's understanding of the universe in which he lives. Prior to 1609, the accepted view of the universe was that the Earth was the center of the universe, with the Sun, Moon and 5 planets orbiting about it. Furthermore, everything else we can see in space was part of the galaxy in which we live, which comprised the entire universe. While Copernicus had proposed a heliocentric universe, relegating Earth to the status of just another planet moving around the Sun, few scientists took it seriously, and no one beyond the astronomical community would have considered such a thing to be possible.

It was Galileo Galilei and his extraordinary work with the newly-invented telescope in the early 1600s that forever changed our understanding of our place in the universe. Since that time, the telescope has continued to expand our knowledge and our questions about the vast cosmos in which we live. While today's telescopes are capable of showing us the universe in a way which Galileo could have never conceived, they are still constructed on and function via the same principles by which Galileo's simple telescope worked.

In this program, students will receive an overview of the history of the telescope, as well as exploring how telescopes work and the kinds of discoveries they have permitted astronomers to make through the ages. Before the show, you may want to discuss with your class the electromagnetic spectrum and its various kinds of light. Students should be prepared to think critically about the material presented in the planetarium show and be ready to ask questions after the program.

Concepts Covered During the Planetarium Visit

1. The invention of the telescope was a turning point in the history of astronomical thought. Use of telescopes has greatly expanded our knowledge and understanding of the universe around us in a short period of time.
2. The earliest telescopes were of a simple design using two small lenses. Later designs incorporated mirrors as the primary light-gathering device. All telescopes today are still based on these simple designs, though modern telescopes now use computers to assist astronomers in their discoveries.
3. Light of all types across the electromagnetic spectrum can be gathered using various types of telescopes. Images created using these different types of light have greatly expanded what we can learn using telescopes and how we see and interpret the universe around us.

Pre-Visit Activities

We recommend that you conduct at least one of these activities with the class before your visit to the planetarium theater. Be sure to raise questions that can be left unanswered until the discussion period in the show.

1. Talk about our understanding of the universe prior to the year 1600. How did it differ from what we understand today? Why do you think people believed this for so long?
2. Learn about how the Hubble Space Telescope makes the amazing images we receive from it. Does Hubble use only visible light? Are the colors in all Hubble photographs exactly what we would see if we were there? If not, what do the colors mean? Visit hubblesite.org to get started exploring the Hubble Space Telescope.
3. Observe the night sky with a telescope. If you do not have a telescope available, contact us! We rent telescopes for \$5 per night. We also have free monthly public star parties on the second Saturday of every month, or for an additional fee we can conduct a private star party for your class. To discuss these options or make reservations, please contact the Astronomy Curator at (757) 595-1900 x256.

Post-Visit Activities

We recommend that you conduct at least one of these activities with your class following their visit to the planetarium theater.

1. Investigate the life of one of the scientists responsible for the revolution in astronomical thought which occurred during the 1500s – 1700s. Did most of the scientists of the day accept these new ideas immediately? Compare this process of changing scientific thinking to the current controversy over the status of Pluto.
2. Build your own telescope! Simple, inexpensive telescope construction kits can be purchased from Learning Technologies, Inc. or from Galileoscope Inc. How do these instruments compare to the telescope used by Galileo? Replicate Galileo's observations of the Moon, Jupiter and Venus and see if you can also replicate his findings.
3. Which object in the universe would you wish to study if you could book time on a space telescope? Why?

Recommended Books and Web Sites

The Hubble Space Telescope: <http://hubblesite.org>

The James Webb Space Telescope: <http://www.jwst.nasa.gov>

Mauna Kea Observatories: <http://www.ifa.hawaii.edu/mko/>

Cosmos by Carl Sagan

365 Starry Nights by Chet Raymo

365 More Starry Nights by Chet Raymo

Galileo Galilei at Wikipedia: http://en.wikipedia.org/wiki/Galileo_Galilei

Virginia Living Museum and Abbitt Planetarium: <http://www.thevlm.org>

