Teacher's Guide to

"TWO SMALL PIECES OF GLASS – THE AMAZING TELESCOPE"

OBJECTIVES:

- To distinguish between reflection and refraction
- To describe how a telescope forms an image
- To explore the history of telescopes from Galileo to today's mountaintop observatories
- To describe how technological advances have improved the telescope which allow scientists to make new discoveries.

This show conforms to the following national & state science standards: MS-ESS1-2, MS-ESS1-3

BRIEF SHOW DESCRIPTION:

400 years ago, a simple adjustment to a child's spyglass revealed for the first time an infinite and perplexing universe to our eyes and imaginations. Today, as the world's great telescopes gaze ever further into the distant past — and into our future. While attending a local star party, two teenage students learn how the telescope has helped us understand our place in space and how telescopes continue to expand our understanding of the Universe. Their conversation with a female astronomer enlightens them on the history of the telescope and the discoveries these wonderful tools have made. The students see how telescopes work and how the largest observatories in the world use these instruments to explore the mysteries of the universe. While looking through the astronomer's telescope, the students, along with the planetarium audience, explore the Galilean Moons, Saturn's rings, and spiral structure of galaxies. During their conversation with the astronomer, they also learn about the discoveries of Galileo, Huygens, Newton, Hubble and many others.

PREVISIT ACTIVITIES/TOPICS FOR DISCUSSION:

- Discuss with the class what telescopes do. Most will say telescopes magnify things, which they do, but the most important function is to collect more light then your eye. The eye, when dialated, is roughly ¼ inch in diameter and most light misses the orifice. You can illustrate this by trying to fill a water bottle (with a small opening) with a pitcher. If the water spills, have the class brainstorm how the most water can reach the bottle. Eventually end up with a funnel. Telescopes are "light funnels!"
- Look at the web site "Telescopes from the Ground Up" to see the history of telescopes (http://amazingspace.org/resources/explorations/groundup/)
- Discuss how the telescope revolutionized the way we think about our place in the universe. Early people thought the Sun went around us and that makes good sense. Can you *prove* the Earth goes around the Sun? How? What is the evidence? (Hint: it is actually easier to show that everything goes around the Earth! The proof of a sun-centered solar system came with pendulums!) Maybe set-up a debate with a team proposing the Earth moves and one proposing it is stationary. Who wins?

POSTVISIT ACTIVITIES/TOPICS FOR DISCUSSION:

- Purchase inexpensive telescope kits for the class and have the students assemble them themselves: http://shop.sciencefirst.com/astronomy-planetariums/3493-refracting-telescope-single.html
- Purchase a "Galileoscope" and set it up to operate like Galileo's telescope. How did he ever make all those discoveries with such a small field of view? http://galileoscope.org/
- Galileo provided the evidence that the Sun is the center of our solar system. This was a major cultural shift in our way of thinking. But why? What was the big deal? Does it make a difference?
- Why put telescopes in space? Is it worth the cost?
- Want to show how light behaves in a telescope? Try Light Blox: http://store.laserclassroom.com/light-blox/
- What about the universe our eyes cannot see? Here's a cool web site on the infrared universe: http://coolcosmos.ipac.caltech.edu/
- What careers are available in the field of astronomy? (https://aas.org/education)

VOCABULARY LIST:

Telescope	Galileo
Focal length	Resolution
Magnification	

INTERNET RESOURCES:

- Look through real telescopes with the CU Astronomical Society (http://www.cuas.org) or the Astronomical Society at the University of Illinois (http://uias.astro.illinois.edu/index.html) and the University of Illinois Observatory (https://astro.illinois.edu/newsroom/history-department/campus-observatory)
- Good telescopes for beginners: http://www.telescope.com
- The web site for the show: https://www.eso.org/public/usa/videos/tspog/
- "Imagine the Universe" lesson plans: http://imagine.gsfc.nasa.gov/educators/index.html
- Optics for kids: http://www.optics4kids.org/home/
- Hubble Space Telescope site: http://hubblesite.org.