The Senator John Heinz History Center provides a range of exciting learning opportunities, from guided tours to hands-on sessions in the archives and dramatic visits with historic characters. Please visit the History Center website at www.heinzhistorycenter.org/education to learn more about these experiences.

EDUCATION PROGRAMS
Engage students with the scope of American history through experiences of Western Pennsylvanians over the past 250 years. Students will explore topics through investigative questioning and hands-on discovery. Programs designed for elementary audiences are described below.

Setting the Scene: Macaroni Boy
This inquiry-based exploration of Pittsburgh’s Strip District utilizes historic images, maps, and first-person accounts to bring to life Katherine Ayres’ “Macaroni Boy.” Archival images allow students to compare and contrast settings from the book with the historic evidence. An interactive game brings the story full circle with a look at the Strip District today.

We’re All Immigrants
Life in Western Pennsylvania has changed drastically over the 16,000 years since the arrival of the region’s first peoples at the Meadowcroft Rockshelter in Avella, PA. Explore how people have made this area their home throughout time through hands-on gallery activities. Artifact analysis and community case studies emphasize the common thread of immigration that connects all Pittsburghers.

Pittsburgh’s Past
Travel back in time to explore Pittsburgh’s rich history through objects and exhibits that bring Western Pennsylvania’s stories to life. Students will journey into the past during this investigative program that introduces famous Pittsburghers, charts continuity and change in the city’s history, and provides hands-on experiences in the galleries.

GUIDED TOURS
The History Center offers multi-disciplinary and interactive guided tours for students of all ages that are both educational and fun. Guided tours follow thematic routes through the History Center’s five floors of dynamic exhibits, showcasing the region’s history in a way that supports standards-aligned learning.

Tours generally include a visit to four exhibits (30 minutes per exhibit) that share a common theme. Teachers should choose one of the following themes to focus their tour through Western Pennsylvania history.
- Beyond Adversity: African American History in Pittsburgh
- Pittsburgh People: Immigration and Migration
- Made Here, Shipped There: Transportation and Innovation
- Pittsburgh’s Pastimes: Sports, Entertainment, and Leisure
- Placing Pittsburgh: Cultural Geography

SELF-GUIDED TOURS
Self-Guided tours are for teachers who facilitate their own museum experience. We encourage teachers to tour our building in preparation for their visit. Worksheets or scavenger hunts designed by the teacher are highly recommended. Self-guided tours are for a maximum of 200 students, pre-kindergarten students through 12th grade. They are one to two hours in length, plus a half-hour for lunch. These tours feature a museum overview, an introduction by a museum educator and include a map of the History Center and exhibit directory.

STEM: CONNECTING INNOVATION, HISTORY, AND SCIENCE
Inventions and innovations born in Pittsburgh have impacted the world, and new STEM programs connect the historical impact of these achievements with the scientific process and understanding that made them possible. Spanning specialties and subject matter - Pittsburgh: A Tradition of Innovation introduces students to innovators with tenacity, strong-willed women and scientists with a purpose. These trailblazers have made an incredible impact on the world. These programs encourage students to feel inventive and deepen their interest in the history and future of innovation.

The STEM activity tracks compliment a variety of classroom subject matter:
- Medicine + Mechanisms: Discovery through trials, tenacity and teamwork
- A Better World: Improving the quality of our lives through innovation
- Systems Thinking: Building robots and examining historical impact through mapping and gaming
- 3 Rivers, 3 Material: Three processes realized in Pittsburgh impacted industry around the world – Glass, Aluminum, and Steel

For more information or to schedule a school visit, call the History Center’s Group Tour Coordinator at: 412-454-6304 or masatler@heinzhistorycenter.org.
The Next Galileo
Teacher Guide

The Next Galileo
Teacher Guide

The activities in this Teacher Guide are designed to link Galileo’s experience of discovery explored in the musical with Pittsburgh’s important history of astronomy connected to the Allegheny Observatory.

Background Information: Allegheny Observatory

The Allegheny Telescope Association was founded in 1859 by businessmen from Allegheny City. By 1862, they had purchased a large refracting telescope and had constructed an observatory. They were casual observers and by 1867 interest in astronomy waned and the trustees voted to donate the observatory and its telescope to Western University of Pennsylvania (now the University of Pittsburgh). The university began a search for a director who would initiate scientific research at the site. During the latter half of the 19th century Samuel Langley and James Keeler conducted inquiries into the nature of the sun and the planets in our solar system. At the turn of the century, John Brashear led a drive to build a new and bigger observatory in Riverview Park. The new observatory opened in 1905 under director Frank Schlesinger. The new observatory focused on binary stars and the determination of stellar distances. In recent years, Director George Gatewood initiated a program to search for exo-planets (planets around stars beyond our solar system). Currently, University of Pittsburgh students are engaged in a program to detect exo-planets by observing the transits of planets across the face of the parent star temporarily dim the light from that star.

Student Activity: Lunar Observations

Observation is a useful skill because it helps students understand a process they are seeing for themselves. As Galileo and others before him discovered, observation is the key to learning. It is also a useful exercise in training the eye to notice things. In this activity, students will conduct a study of the moon. This activity is designed to be done as an outside-of-class exercise.

Materials Required:
• Compass
• Pencil
• Sheet of yellow construction paper
• Scissors
• Sheet of white paper
• Glue stick
• Watch

Activity
1. Using the compass, draw eight 1 inch diameter circles on the sheet of yellow paper. Cut out the circles.
2. In the early evening of a clear day, just after sunset, go outside and locate the moon. This should be conducted just before or during a full moon. Facing the moon, note the various structures and trees that are in front of you and on either side of you. On the white paper, draw the trees, houses, streetlights, or other landscape you see below the moon.
3. Use the glue stick to paste one of the colored circles onto the paper in the position where it appears. If the moon is not a full moon, draw the shape of the moon as you see it inside the circle. Write the time inside the circle.
4. Go back outside a half-hour later and find the moon again. Paste another colored circle where the moon’s new position is and write the time on it. Repeat this again every half-hour for as long as you are allowed to stay up.
5. What can you conclude from your observations?
Building an Astronomical Instrument: A Spectroscope

Teacher Preparation
In the musical, students are introduced to the important astronomical discoveries made by Galileo as he innovated the use of the telescope. Astronomy has been an important part of Pittsburgh’s history too, with work conducted at the Allegheny Observatory to document the sun, planets, and solar system. This activity explores one of the instruments used at the observatory. This hands-on learning experience allows students to see that what appears to be “ordinary” light actually contains different components, and that features within those components provide information about the chemical composition of a light source.

Background Information: The Spectroscope
No matter how good your telescope, a star is only a point of light. The primary way of learning about distant objects is through their light (electromagnetic spectrum). Light has “fingerprints” that provides information about it, which can be seen through a spectroscope. Spectroscopy is a key tool in astronomy. By obtaining and analyzing the spectrum from a distant object, astronomers can identify what type of object it is and determine a wealth of characteristics for the object. These include its effective temperature, how fast it is rotating and whether it is moving towards or away from us, how large and dense it is and what it is made of.

Saturn, Pittsburgh, and the Spectroscope
James Keeler was appointed the head of the Allegheny Observatory in 1891. In 1895, he made observations of the rings of Saturn with a spectrograph attached to the 13-inch Fitz-Clark refracting telescope. This spectroscopic study revealed that different parts of the rings reflect light with different Doppler shifts, due to their varying rates of orbit around Saturn. This was the first observational confirmation that the rings are made up of countless small objects, each orbiting Saturn at its own rate.

Materials Required
• Download background and instructional video: http://vimeo.com/58334879
• Cardboard tube, such as from a paper towel roll
• Cellophane tape
• Aluminum foil
• Utility knife (e.g., “X-acto”)
• Rubber band
• Scissors (for trimming diffraction grating)
• Diffraction grating film (Diffraction grating film is available from scientific educational supply companies online. Search under “diffraction grating film.” The diffraction grating film used in the video was obtained from: Rainbow Symphony Store, http://www.rainbowsymphonystore.com, Catalog number 01504 – 1000 lines/mm).

Classroom Activity
1. Prepare students to take on the role of an astronomer, much like Galileo, by asking how they think we learn about the sky and solar system? Since Galileo’s time other tools have been developed to provide a better understanding of what is seen through the telescope.
2. Introduce the Spectroscope as one of these important tools. Share this short film with students about the use of the spectroscope in Pittsburgh: http://vimeo.com/45147028.
4. Allow students to examine different types of light sources and record their observations. Use the observation worksheet on page 41 of this teaching resource developed by the Stanford Solar Center: http://solar-center.stanford.edu/activities/SunAndStars5-8.pdf
5. Ask students to describe the exploration and discovery process. Focus on the emotional reward that comes with choosing and making one’s own discoveries. The experience of the reward that comes with satisfying one’s own natural curiosity coupled with the surprise of discovery is a central theme to both The Next Galileo and to encouraging genuine interest in science.
John Brashear: A Study of Perseverance

Teacher Preparation
Galileo conveys to Gabriella the message of trusting curiosity and persevering in "wonder." This activity encourages students to think about perseverance in the face of adversity and following curiosity. Students are introduced to John Brashear, who went from the position of a millwright in a steel mill on Pittsburgh’s South Side to becoming one of the most successful producers of telescopes and precision scientific instruments in the world.

Background Information: John Brashear
John Brashear was born in Fayette County in 1840. He fell in love with the stars at age 9 when his grandfather gave him the opportunity to view the rings of Saturn through a traveling telescope. An enduring love of astronomy and applied science drove Brashear to work on creating a better telescope lens. After five years of holding a full-time mill machinist job by day and working by night in a coal shed behind his home, Brashear and his wife Phoebe produced a 5” diameter telescope lens. He visited the Allegheny Observatory and presented his lens to the director, Samuel Langley. Langley was impressed and he encouraged Brashear to make a telescope mirror as his next project. To silver the mirror, Brashear perfected a new technique. With the encouragement of Langley, he opened an optical shop near the observatory, where he created lenses and scientific equipment for astronomical research. Brashear’s instruments facilitated Langley’s solar research and James Keeler’s pioneering spectrographic observations of Saturn’s rings.

Materials Required:
• Excerpt from Brashear’s autobiography. Printed copies of pages 31-34 of Brashear’s autobiography, John Brashear: The Autobiography of the Man who Loved the Stars, available online at Historic Pittsburgh (http://digital.library.pitt.edu/cgi-bin/t/text/text-id?idno =00c867671m;view=toc;c=pitttext).
• Images of John Brashear, available online at Historic Pittsburgh.
• Pencil and paper for letter writing

Classroom Activity:
1. Ask students to discuss how they think someone becomes a scientist. Introduce John Brashear, showing students a photograph of him from the online Historic Pittsburgh collections. Brashear received little formal education, but was drawn to science out of a natural curiosity that grew from his first experience with a telescope as a child.

2. Provide students with the excerpt from Brashear’s account of his “Making the First Telescope.” This short excerpt describes how he crafted the first lens only to drop it just after the final polish, two years after he first began working on it. Ask students to describe the process as Brashear recalls it in his book.

3. Have students write a short letter to Mr. Brashear advising him on whether or not he should continue the work on the lens. After students share their responses and explain the advice that they offered, help students reflect on their decision-making process – what options did the students present to Mr. Brashear? Were there valid reasons to follow both courses: persevering and giving up to start with something else? Was it worth investing many more months in developing the same lens?

4. Let students discover what happened after the lens-dropping accident by reading the first part of the chapter in its entirety, which can be found on Historic Pittsburgh. Brashear preserved in his efforts and became a successful maker of scientific instruments. Ask students to share experiences where they have had to persevere at something in their own lives.

5. What were the benefits of continuing his work? He describes being able to refine his process after having to so quickly start working on another lens.

6. Conclude with a discussion of the scientific advances that were made as a result of Brashear’s work after he persevered beyond the initial accident.

7. Discussion can be extended to talk about the character traits seen in Brashear’s story and how these influenced his scientific work.

Selection from John Brashear’s autobiography
Just as we would approach a time when we thought we could polish the surface, we would get a scratch on it, and it would have to be done over again. One evening when I had one of the surfaces in pretty good shape to be polished — and by the way, I made the grinding and polishing tools myself — I had the misfortune to drop the crown lens. It broke in two pieces, and broke my heart, as well as my wife’s, in a good many hundred pieces!
Extension Ideas

“I simply built something better . . .”
Galileo did not invent the telescope. The invention of the telescope is credited to a Dutch eyeglass maker named Hans Lippershey, but Galileo is remembered in history because he innovated the use of the telescope by using it to look towards the sky. History is full of examples where the innovator, who “built something better,” is remembered more than the inventor. For example, students often learn that Johann Gutenberg invented the printing press. The printing trade, however, was well established before Gutenberg’s time, using woodblock technology invented in China. The genius of Gutenberg’s innovation was to split the text into its individual components, such as lower and upper case letters and punctuation marks, to mass produce moveable type. Ask students to research other examples where the innovator who “built something better” becomes the remembered face of the invention.

“Follow your questions wherever they go . . .”
In the musical, Galileo’s father encourages his son to “follow your questions wherever they go.” The scientific process is born out of questions and curiosity. Ask students to mind map a question that they are curious about (blank templates are available at http://www.mymindmap.net/Mind_Map_Templates.html). How many more questions are generated from their initial question? How would they go about trying to answer each of these questions? Could it be done based on informational research or would it require an experiment?

“Speaking against what is accepted . . .”
When Galileo is trying to decide if he should speak out against the accepted Aristotelian ideas, his professor reminds him of Giordano Bruno. Bruno was an Italian philosopher, astronomer, and mathematician who developed theories of infinite worlds and spoke out against the traditional geocentric (or Earth-centered) astronomy. He was ultimately tried for heresy by the Roman Inquisition and burned at the stake in 1600. In the musical, Professor Cremonini urges Galileo to think about others who came before him who were persecuted for speaking out against what was accepted, including Socrates, Thomas Becket, and Joan of Arc. Ask students to research examples of people who have spoken out in more recent history. How are people in modern history persecuted for speaking out? What are examples of new theories or ideas being successfully adopted?

“Just like her hero . . .”
At the conclusion of the musical, Gabriella decides to become an astronomer, like her new hero, Galileo. Have students discuss who their heroes are. Who inspires them and what kind of work do they find exciting? For inspirational examples of local astronomers, watch the movie, Undaunted: The Forgotten Giants of the Allegheny Observatory. This DVD is available for loan from the Heinz History Center by contacting Nate Rodda, Education Programs Coordinator, at nrrodda@heinzhistorycenter.org.
At a performance you see the finished product – actors and actresses singing and dancing with colorful costumes and scenery. But what goes into the creation of a musical? In this section, we break down the show into all of its components to give you a better understanding of the magic behind musical theater.

**THE WRITERS**

Most musicals are broken up into three parts: the Book, the Lyrics and the Music. Often, these are divided among three people. The Playwright writes the script, or the lines that the actors speak. This is referred to as the Book. The Lyricist writes the words that the actors sing. And the Composer writes the music that the band or orchestra plays and the notes that the actors sing. When the three writers work together, it is called a collaboration. The three individuals share ideas and influence each other’s writing. They work separately on their jobs and then come together and share their work. They then revise and rewrite until they think the show is ready to be produced.

For *The Next Galileo*, the book, lyrics and music were written by one person.

**THE ARTISTIC STAFF**

The Director does just what their job sounds like. They direct the play. But there’s much more that goes into a Director’s job. It is the Director’s responsibility to make sure the show has a successful run from start to finish. First, the Director meets with the Costume and Scenery Designers who will build the costumes and scenery. They make sure that the designs match the writers’ vision of the play. Assisting the Director is the Stage Manager, who schedules meetings between the Designers and Director and rounds up any materials or props that may be needed for the play. The Director hires the Choreographer and the Music Director. The Choreographer creates and teaches all of the dancing or stylized movement for the show. The Music Director teaches all of the music to the performers and usually works with the orchestra. The Stage Crew works back stage and moves scenery and helps the actors change costumes. They also run lights and sound. They are the unsung heroes that you hardly think of when you see a play. But where do they get people to perform in the play? Where do they get the Actors and Actresses?

**THE PERFORMERS**

An audition is how actors get their jobs. For a musical, the actors come to the theater with a song or two prepared and sing for the Director, Choreographer and Musical Director.

If the artistic staff thinks that they may be right for the show, they are invited to a callback. A callback is a second audition where the performers are asked not only to sing again, but also to read from the script and dance a combination taught by the Choreographer. If they make the cut, they are invited to act in the show.

**THE REHEARSALS**

A rehearsal is the period of time where the actors learn their lines, songs and where to move on the stage – also known as “blocking.” In *The Next Galileo*, the actors learned it all in five days!!! They are truly professional. The final practice for the show is called the Dress Rehearsal. Here, the actors, artistic staff, crew and designers put it all together to create the “finished” product. The actors wear their costumes and practice on the completed set. The Dress Rehearsal is usually the first and only time they get to run the completed show non-stop without an audience. After the dress rehearsal – it’s opening! As you can see, there are quite a lot of things that go into the making of a musical.

Truthfully, we’ve just touched on the many jobs that make up a musical. However, we hope that this has opened your eyes to this theater experience and made you appreciate all the different talents that go into creating a show.
PITTSBURGH CLO ACADEMY OF MUSICAL THEATER • Just a few blocks from the bright lights of the Benedum Center, the sound of booming pianos bounces off the brightly painted walls of Pittsburgh CLO Academy of Musical Theater as children of all ages enthusiastically train for their moment in the spotlight. Providing the finest dance, music, and acting training, and affiliated with one of the most respected musical theater organizations in the country, the Pittsburgh CLO Academy encourages both an appreciation for musical theater and a well-rounded education through professional quality courses.

CLO ACADEMY SUMMER CAMPS • Pittsburgh CLO Academy’s one, two and three-week summer performance camps are designed to present students with a professional environment that combines creativity with skill development and performance opportunity. Working with professional Directors, Music Directors and Choreographers, students will be involved in a musical theater experience with memories to last a lifetime!

CLO MINI STARS • An ultra-talented troupe of young performers who showcase their high-energy Broadway song and dance extravaganzas throughout the Tri-State area. Their special brand of musical theater magic has excited hundreds of thousands in their 29-year history.

GALLERY OF HEROES • Through dramatic sketches and musical vignettes, this program takes its 50-minute mini-musicals to area schools to educate and enlighten students about great historical figures such as Roberto Clemente, the Wright Brothers and Harriet Tubman. Highlighting the lives and accomplishments of significant historical figures, the Gallery of Heroes program offers an entertaining alternative to traditional lectures and books.

GENE KELLY AWARDS • Presented in partnership with the University of Pittsburgh, the Gene Kelly Awards are a Tony Awards®-style celebration of excellence in high school musical theater in Allegheny County. High School theater programs are the clear winners as show business veterans and community celebrities help spread the word about the achievements of area high schools and their musical theater programs. Created in 1991, the Gene Kelly Awards have become a Pittsburgh tradition. The Best Actor and Best Actress each year go on to compete at the National High School Musical Theater Awards in New York City.

NEW HORIZONS • Pittsburgh CLO’s musical theater training program for students with physical and developmental disabilities and autism. Barriers are broken down as the participants realize the power of art, music and theater and their own untapped abilities.

CREATIVE VISION • Pittsburgh CLO’s partnership with the Pittsburgh Public School System and Propel Schools. Training in Dance, Voice and Acting combine with student creativity and accountability to promote participants’ interest not only in the arts, but in themselves, their own lives and futures.

“A” IN ARTS • Pittsburgh CLO’s way of recognizing excellence in school arts programs. Students trade A’s in high school arts classes for tickets to select Pittsburgh CLO productions at the Benedum Center.

STUDENT COUPONS • Another way Pittsburgh CLO makes theater accessible to young people. Students see four shows for $40. For more information, call 412-281-2822.

For more information about these programs, call 412-281-2234 or visit pittsburghCLO.org