Unit 2/Week 1

Title: Galileo

Suggested Time: 5 days (45 minutes per day)

Common Core ELA Standards: RI.5.1, RI.5.2, RI.5.3, RI.5.8, RI.5.10; RF.5.3, RF.5.4; W.5.4, W.5.8; SL.5.1, SL.5.2; L.5.1, L.5.2, L.5.5

Teacher Instructions

*Refer to the Introduction for further details.*

**Before Teaching**

1. Read the Big Ideas and Key Understandings and the Synopsis. Please do **not** read this to the students. This is a description for teachers, about the big ideas and key understanding that students should take away **after** completing this task.

Big Ideas and Key Understandings

The unknowns in astronomy in Galileo’s time brought out Galileo’s creativity, curiosity, and motivation whereas these same unknowns unsettled others and caused them to silence those who opposed their views.

Synopsis:

Galileo refines the telescope and becomes one of the pioneers of astronomy. He discovers that the Earth is not a still body around which the sun revolves. This novel idea is unsettling to the Church at the time and Galileo is punished by the Church. He had to withdraw this idea and never speak of it publicly.

1. Read entire main selection text, keeping in mind the Big Ideas and Key Understandings.
2. Re-read the main selection text while noting the stopping points for the Text Dependent Questions and Vocabulary.

**During Teaching**

1. Students read the entire main selection text independently.
2. Teacher reads the main selection text aloud with students following along.
3. Students and teacher re-read the text while stopping to respond to and discuss the questions and returning to the text. A variety of methods can be used to structure the reading and discussion (i.e., whole class discussion, think-pair-share, independent written response, group work, etc.)

Text Dependent Questions

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| **Text Dependent Questions** | **Answers** |
| Describe why the “tube” was an exciting invention to Galileo.  What was Galileo’s hypothesis about the 2 lenses? | The new tube made distant objects appear closer. When Galileo drew the 2 lenses, he made the hypothesis that if the concave lens was placed the right distance behind the convex lens, it would magnify light. |
| Demolish, from *de-* "down" + *moliri* "build, construct” means to destroy or breakdown. What does the author mean when he wrote, “now he would make a tube to demolish distance”? | The author meant that the power of the telescope is able to “break down” the distance between where a person is observing to what they are seeing through the telescope. |
| What evidence does the author provide that demonstrates Galileo’s character? | Galileo is a problem solver and creative thinker. The evidence includes the fact that he worked diligently until he was able to create the telescope. To find out how much it magnified, he was creative enough cut different sized circles of paper to compare the size difference between what he can see with the naked eye and with the scope. |
| What evidence proves Galileo’s hypothesis? | The Venetians “found that they could see ships sailing towards them a good two hours before they were visible to the naked eye.” |
| How did Galileo’s findings motivate him even further? | He was motivated to improve/increase the magnification and to go beyond the seas and explore the heavens. |
| What about the moon puzzled Galileo? | “He noticed that the boundary between light and dark on the moon’s surface was wavy and uneven. Also he saw bright spots of light dotted over the dark areas.” (Students can draw a picture from this description to help them visualize what was seen through the telescope.) |
| What deductions, new ideas based on evidence, about the moon did he make? Quoting evidence from the text, why did the author describe these deductions as ‘bold’? | He deduced that the “spots of light are mountain peaks bathed in sunlight.” Also, he decided that the wavy line at the boundary between light and dark was there because of the mountains. These new ideas were bold because the author noted that, “Until then no one had seriously supposed that the Moon might be something like the Earth,” with landforms such as mountains. |
| Through his invention of the stronger magnification of the telescope, what were Galileo’s discoveries? | The constellation of Pleides had 43 stars rather than 7. The Milky Way was a “crowded cluster” of stars. “The number of small (stars) is beyond determination.” Jupiter has 4 moons that ‘swing’ around it, just as the Earth has 1. |
| What discoveries did Galileo make about the sun and how did they differ from the views of the time? | He traced the movement of the mysterious spots across the sun and deduced that the sun was spinning around its own axis. This differed from the popular belief, specifically from the Church of Rome, of that time that celestial bodies “ought to be without blemish.” “The movement of the spots also suggested that the sun was not still, it was moving on its own axis, as Earth was.” |
| How did Galileo openly defy the Church? How was the defiance resolved? | “In 1623, a new pope was elected, and the Church hardened against Galileo. He received warnings, but would not give way.” Galileo publicly defied the church by publishing the *Dialogue on the Great World Systems*, which stated the Earth did not stand still, but circled the sun. This conclusion greatly differed from the Church’s belief that the Earth did not move and was the center of the universe. The defiance was resolved with Galileo never again speaking publicly against the Church’s beliefs. |
| What is the author’s position on the conflict between Galileo and the Roman Catholic Church? What evidence from the text leads you to believe that? | The author has a positive view of Galileo. I can tell that the author sides with Galileo by what the author chose to write about. The author wrote about Galileo’s many successes and discoveries starting from the recreation of the Dutch cylinder to the discovery that the Earth circled the sun. The author stated, “His discoveries made Galileo a much more important man”. The author spoke of Galileo with positive phrases such as “(he) opened up a new vision of the heavens”, he had a “brilliant argument in favor of his beliefs”, and “the great astronomer was now seventy years old . . .” By choosing to write about Galileo’s discoveries and using positive words and phrases to describe Galileo, I can conclude that the author has a positive view of Galileo. |

Vocabulary

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|  | **KEY WORDS ESSENTIAL TO UNDERSTANDING** | **WORDS WORTH KNOWING**  General teaching suggestions are provided in the Introduction |
| **TEACHER PROVIDES DEFINITION**  not enough contextual clues provided in the text | heavenly bodies  apparatus  revelation, constellation  methodical  satellite  defy/defiance | convex, concave, trance  naked eye  primitive  myriads, pendulum |
| **STUDENTS FIGURE OUT THE MEANING**  sufficient context clues are provided in the text | ‘demolish distance’  telescope  unsettling, refrain, curb  unconvinced, hardened, inquisition | obscure, employ  clambered  devised  sharp-eyed, peering, astonishment  bewilderment |

Culminating Task

Re-Read, Think, Discuss, Write

* *Sequence the discoveries Galileo made that led up to the discovery that the Earth was not a still body by creating a Sequencing Map.*

Answer: In a Sequencing Map:

***Galileo’s Discoveries***

* + recreated the Dutch cylinder
  + made a telescope that magnified 3 times
  + made a telescope that magnified 30 times
  + discovered the landscape on the moon
  + examined the other constellations and found more stars
  + discovered that Jupiter has four moons that move around it, just as Earth has one
  + discovered that there are millions and millions of stars
  + discovered that Venus’ appearance changes in the night sky
  + discovered that sun spots move across the sun
  + discovered that the Earth circled the sun

(Rubric: Advanced – response includes 8-9 discoveries; Proficient – 6-7 discoveries; Developing – 5 or less discoveries)

* *Summarize the popular view of the ‘heavens’ in Galileo’s time and contrast Galileo’s discoveries to this popular view.*

Answer: In Galileo’s time, it was believed that the stars were unchanging. It was also believed that heavenly bodies like the moon and planets were unblemished bodies very different from Earth. At that time, most people believed that the Earth did not move and that the Earth was the center of the universe.

Galileo disproved that the stars were unchanging when he refined the telescope to magnify 30 times. The skies simply had myriads of ‘new’ stars because more of them became visible with the use of the telescope. He also discovered that what appeared to be blemishes, bright and dark spots, on the moon were mountaintops and valleys that reflected the sunlight. Similarly, the blemishes on the sun were sun spots that showed the sun was moving on its own axis. He discovered that Jupiter didn’t swing like a pendulum between its moons. Instead, Jupiter’s moons moved around it, just as Earth’s moon orbits Earth. He used all of these discoveries to further conclude that the Earth was not the center of the universe nor was it a still body in the sky.

Additional Tasks

* What lessons about astronomy might this piece teach future scientists, astronomers, and inventors? (Sample

Answer: There are times when we have to be open to new ideas even when it is starkly different from what is accepted and popular. New discoveries always lead to more unknowns.

* Research the contributions of Copernicus to astronomy. Compare and contrast the discoveries of Copernicus and Galileo.
* Galileo’s revolutionary idea that the Earth circles the sun is now considered common knowledge. Research the history of Galileo’s idea and how it has stood the test of time.