

# Clash of Ideas, Episode 1

## Galileo and the Craters of the Moon

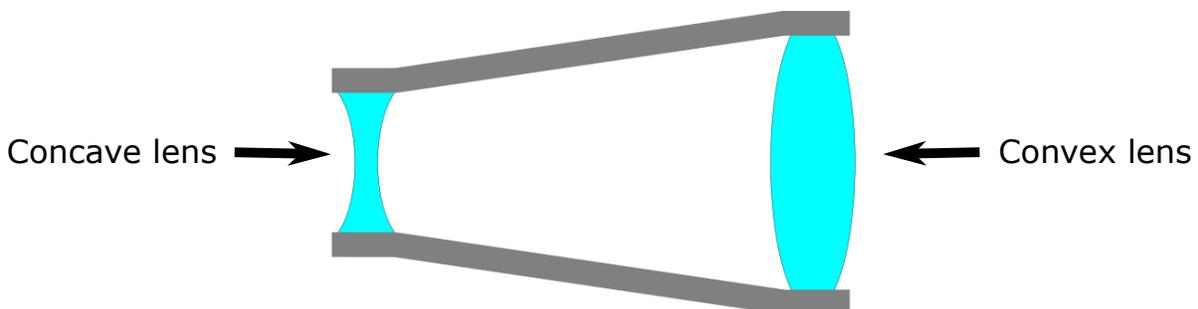


### Engage

- The invention of the telescope gave Galileo the tool he needed to make observations that challenged an accepted scientific model. What was that model? Who was primarily responsible for its development? Who defended it even though Galileo showed that it was wrong?
- Why does the moon go through phases? Why does the shadow on it move from our perspective?
- What does it say about the surface of the moon that the line between the lit and shaded sides of it is jagged?
- Why did Galileo's conclusions about the surface of the moon bring into question the teachings of Aristotle?
- Do you think Galileo questioned Aristotle even before studying the line between the light side and dark side of the moon? Did his critical attitude lead his observations or followed them?

### Discover

- A simple telescope like the one Galileo built can be made with just two lenses, a convex lens and a concave lens. Making clear glass for the lenses is difficult, though. Fortunately for Galileo's telescope, Venice was a center for glass-making and glass-blowing technology.



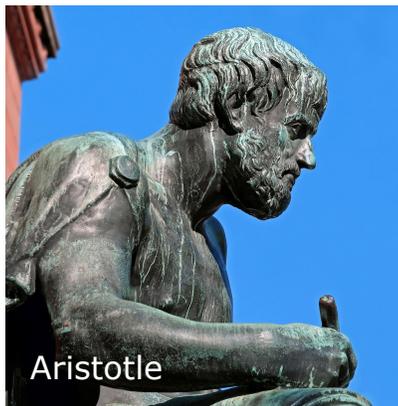
- Experiment to understand the phases of the moon:

You'll need a very dark, preferably large room, a ball, and a point light source like the LED flashlight on a phone. One person should hold the ball out at arm's length while the other points the flashlight in their direction. The person holding the ball should spin slowly, observing the pattern of light and shadow on the ball and noting the "phases" the pattern is moving through.

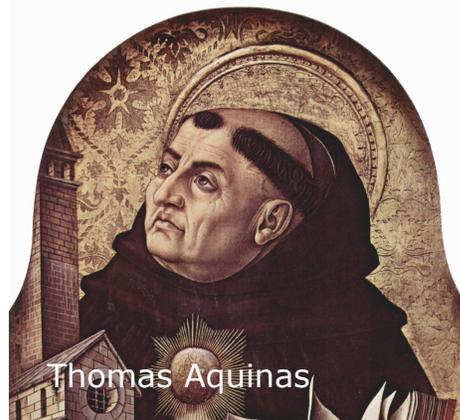
See <https://www.youtube.com/watch?v=fOkEuWXoKXY> for a complete description of the experiment.

## Explain

- Aristotle was born in 384 BC and died in 322 BC. He was born about 155 years after Daniel was thrown into the lions' den and 73 years after Artaxerxes' decree to restore and rebuild Jerusalem recorded in Ezra 7. Even though Aristarchus of Samos proposed a sun-centered model of the solar system and had good data to back up his model, Aristotle believed that the earth was the center of the universe, and that the sun, moon, stars, and planets all revolved around it. Aristotle heavily influenced Thomas Aquinas and other important Catholic theologians, and the Catholic Church held Aristotle's position on the structure of the universe into the 1700s and 1800s.
- An important part of Aristotle's earth-centered, or geocentric model of the universe, was the teaching that the heavenly bodies were perfect, eternal, and unchangeable, while the earth was corrupt and subject to change. When Galileo showed that the moon had craters, mountains, and valleys on it, he upset the people who believed that the moon should be a perfect sphere.



Aristotle



Thomas Aquinas

## Extend

- One of the reasons Galileo got into trouble is that people believed that the earth didn't move in space, and when they read Psalm 104:5, which says that God "set the earth on its foundations; it can never be moved," they were sure the Bible was supporting their position. Many scientists and theologians of Galileo's time took this biblical statement, and others like it, as statements of scientific fact. Now, however, scientists and theologians who believe the Bible is true don't have a problem with Psalm 104:5 and other texts like it, because we accept that Bible writers often made statements from their own perspective, like we still do today. Ecclesiastes 1:5 says, "The sun rises and the sun sets, and hurries back to where it rises." Now, we might ask Google what time the sun will go down on Friday, even though we know that it's really the earth that is spinning and not the sun that's "going down."
- It might be tempting to try to decide for ourselves, based on current scientific knowledge, which verses of the Bible are statements of scientific fact and which are not. We need to watch out for the trap of submitting the Bible to our human ideas, however, and instead we need to submit our ideas to the Word of God. The key to understanding the Bible is to come to the text with humility, asking God for help to understand it, and trusting that God will eventually provide a solution to even the most difficult questions. It's important to remember that every solution that truly comes from God will reveal that He is both loving and powerful.

## Assess/Reflect

- Several ancient Greek astronomers correctly measured the relative sizes of the earth and the moon, and the distance between them. (The diameter of the earth is about 3.67 times the diameter of the moon, and the moon is about 238,900 miles or 384,400 kilometers away from us.) They also correctly measured the diameter of the earth, and they estimated the distance from the earth to the sun as best they could (they didn't have precise enough instruments to measure this value well—Aristarchus of Samos calculated that the sun was 19 times further away than the moon, when it is actually 389 times further away). We are often tempted to think that we need expensive equipment to make scientific discoveries, but the ancient Greek astronomers learned all of this without telescopes or calculators. What do you think this says about what it takes to make scientific discoveries?
- What does Galileo's story say about how we ought to interpret the Bible?
- What is the relationship between the Bible, God's written word, and what nature reveals to us about God?

## Teacher's Resource

### Possible Answers to Questions

- Plato developed a geocentric model of the universe. Aristotle, his most famous student, and Ptolemy, an astronomer who lived from about 90-168 AD are two of the most important figures in the model's further development.

### Further Investigation

- The YouTube channel How To Make Everything has a series on making optical-quality glass, and it really shows how difficult it is and the challenges involved.

### Vocabulary

Immutable: unchanging

Geocentric: model that places the earth at the center of the universe, with the other heavenly bodies orbiting around it

Phase: the moon goes through recurring cycles of appearances from our perspective—these are referred to as phases

Video for exercise available at:

<https://www.grisda.org/audio-visual-media?album=5469010&video=206448345>