



Leader Discussion Guide for *Cosmos: A SpaceTime Odyssey*

Episode 3: "When Knowledge Conquered Fear"

The creators of *Cosmos: A SpaceTime Odyssey* state that their aim is to promote scientific literacy. Because we know that many who watch the program may find the blurring of observational, experimental science with historical, origins science confusing, in this discussion guide for episode three, we emphasize the distinction between what we know about comets and worldview-based speculation about when and how they came to be.

1. What is a comet?

ANSWER: Comets are like "dirty snowballs" in space. They are small, icy rocks that orbit the sun, swinging through our solar system and crossing the paths of planets. Comets are made of frozen substances like water, methane, ammonia, and carbon dioxide mixed with dark particles of "dust." When seen from earth, a comet can look like a temporary star with a tail, like a fire in the sky. The name "comet" comes from a word meaning "hairy star."



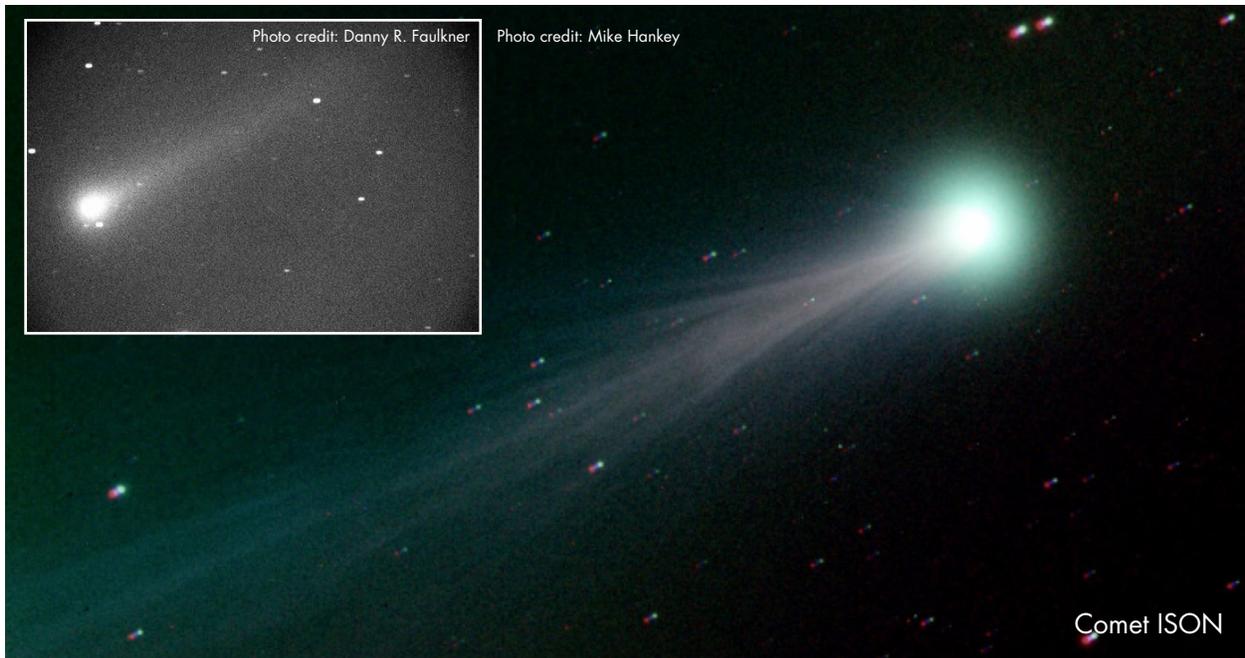
2. What makes a comet glow? Why does a comet have a tail? Does it glow and have a tail all the time?

ANSWER: Comets only glow when they are close enough to the sun to be affected by its heat and radiation. Comets spend much of their time far from the sun, where it is very cold. As elliptical orbits bring them closer to the sun, some of their frozen components are vaporized into gases. Spewing evaporating gases and dust as they approach the hot sun, comets can put on quite a show. These gases expand into the vacuum of space and glow because they are ionized by the sun's ultraviolet radiation. The comet's tail is created as solar wind and radiation push glowing gas and dust away from the sun. The comet's orbital path is elliptical, so it will not glow or have a tail when it is far away from the sun, orbiting in the outermost reaches of our sun's gravitational field.

3. Why did many ancient and medieval people fear comets? What did they think they meant? What does the Bible teach about such beliefs?

ANSWER: Many superstitious people once thought comets were signs that a disaster was about to happen. Some thought that comets were a message from the false gods they worshipped. They did not realize that comets could return at regular intervals because it takes a long time for a comet to swing back near the sun on its long orbit. Such cultures ascribed supernatural significance to the things they observed in the sky—whether regular patterns like nearby planetary motions and the movement of constellations or the seemingly sporadic appearances of comets.

Sadly, even some Christians in the past have been guilty of such superstitious beliefs. However, there is no excuse for anyone who worships the Creator God of the universe and has access to His Word to fear comets or to try to read their future in the stars. God said in Genesis 1:14 that he put the things we see in the sky there “for signs and seasons,” enabling us to mark the passage of time. The Bible also tells us that the “heavens declare the glory of God” (Psalm 19:1). The sky shows God's handiwork. When we see a beautiful comet, we might be reminded that Ecclesiastes 3:11 says God has “made everything beautiful in its time.” However, the Bible specifically condemns the practice of “reading the stars” as omens (Deuteronomy 18:10; cf. 1 Samuel 15:23; 2 Kings 17:17–18; Jeremiah 10:2–3; Isaiah 47:13–14; Leviticus 19:26).



4. **Why does the *Cosmos* program say that comets are in “bondage” to the sun’s gravity? Is this accurate?**

ANSWER: Like the planets, the movements of comets are controlled by the sun’s gravity. The sun’s gravity pulls comets toward the sun, shaping the speeding comet’s path into an elliptical orbit. So yes, a comet is in “bondage” to the sun’s gravity.

5. **How long do comets last?**

ANSWER: Unlike planets, comets are only a few miles across. Much of their mass consists of frozen substances and dust; therefore they are destroyed easily. They can disintegrate when they collide with other comets or with planets whose orbital paths they cross. They can even disintegrate as a result of their interaction with the gravitational field of a large planet. But even if a comet does not bump into something that destroys it, its regular encounter with the heat and radiation of the sun as it swings by on its elliptical orbit will fritter it away. Each time a comet swings close enough to the sun to be seen, spewing glowing gases and dust and trailing a tail in its wake, it loses some of its mass. Eventually nothing of significance will remain. If the solar system were really 4.5 billion years old as evolutionists claim, all comets would have long since been destroyed.

For further study:

<http://www.answersingenesis.org/get-answers/features/comet-ison>

6. **What is the Oort cloud? Has any astronomer ever seen it? Why do some astronomers believe there is an Oort cloud?**

ANSWER: The Oort cloud is supposedly a spherical reservoir of comets at the outermost reaches of our sun's gravitational field. Evolutionists say that it consists of leftover debris from the formation of the planets. Although episode three of *Cosmos: A SpaceTime Odyssey* showed a picture of the Oort cloud enveloping our solar system, the Oort cloud has never been observed. Those who claim—contrary to the Bible—that the solar system is 4.5 billion years old cannot explain the continued existence of comets if they admit that comets have been following their elliptical orbits ever since the planets formed. Therefore, even though—as the late evolutionary astronomer Carl Sagan wrote in his book *Comet*—“there is not yet a shred of direct observational evidence for its existence,”¹ evolutionists insist the Oort cloud exists because they need for it to exist. Comets are evidence that the solar system is very young, as the Bible indicates.

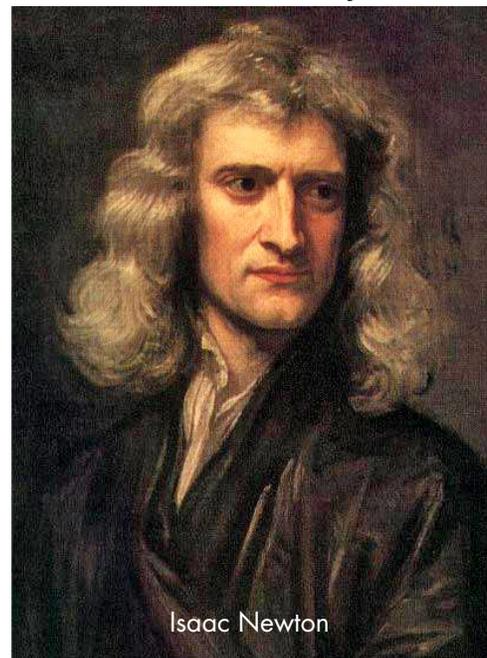
For further study:

<http://www.answersingenesis.org/articles/am/v8/n4/comet-ison>

<http://www.answersingenesis.org/articles/am/v3/n1/heavens-declare-young-solar-system>

7. **In *Cosmos: A SpaceTime Odyssey*, host Neil deGrasse Tyson says Isaac Newton's “laws of gravity and motion reveal how the sun held distant worlds captive. His laws swept away the need for a master Clockmaker to explain the precision and beauty of the solar system. Gravity is the clockmaker.” What does this mean? Is he correct?**

ANSWER: *Cosmos* host Tyson thinks that people only believe in a Creator God, a master Designer—a “Clockmaker”—if they do not understand how something in nature works. Therefore, because gravity explains why planets move the way they do, he implies that gravity is the force responsible for creating the solar system and that a Creator God is just an outmoded idea. He is wrong.



Isaac Newton

1 Sagan, Carl and Ann Druyan, *Comet* (New York: Random House, 1985), 201.

Just because we can apply the scientific method to discover *how something works* does not explain its *origins*. Furthermore, the natural laws that Kepler, Newton, and others discovered—the laws of motion, the law of gravity, the laws of planetary motion, and so forth—also require an origin. God is the source of the natural laws that govern the universe He created.

8. **Cosmos** host Neil deGrasse Tyson indicates that believing a Creator—like a master “Clockmaker”—created the solar system is a belief that limits scientific curiosity and the desire to discover. He says, “This explanation was the closing of a door. It doesn’t lead to other questions.” Based on history, is he correct?

ANSWER: Tyson is wrong. History testifies that belief in a Creator as described in the Bible does not limit scientific curiosity and the desire to discover what natural laws govern our universe. Isaac Newton and Johannes Kepler both believed that the Bible was true. Like most of their contemporaries, these men had a biblical worldview that equipped them to trust that an all-powerful Creator, who had created all things in an orderly fashion, would have designed this universe to be consistently governed by natural laws. They set out to discover what those natural laws were.



Far from having their scientific curiosity squelched, believing in a Creator did not “close the door” on their curiosity to explore “other questions.” In fact, it was Kepler’s belief that a wise Creator as described in the Bible would have created a universe that works logically—like a clock—that led him to pursue his questions about how the planets moved and discover the laws of planetary motion. Then as now creation scientists understand there is no conflict between science and biblical faith.

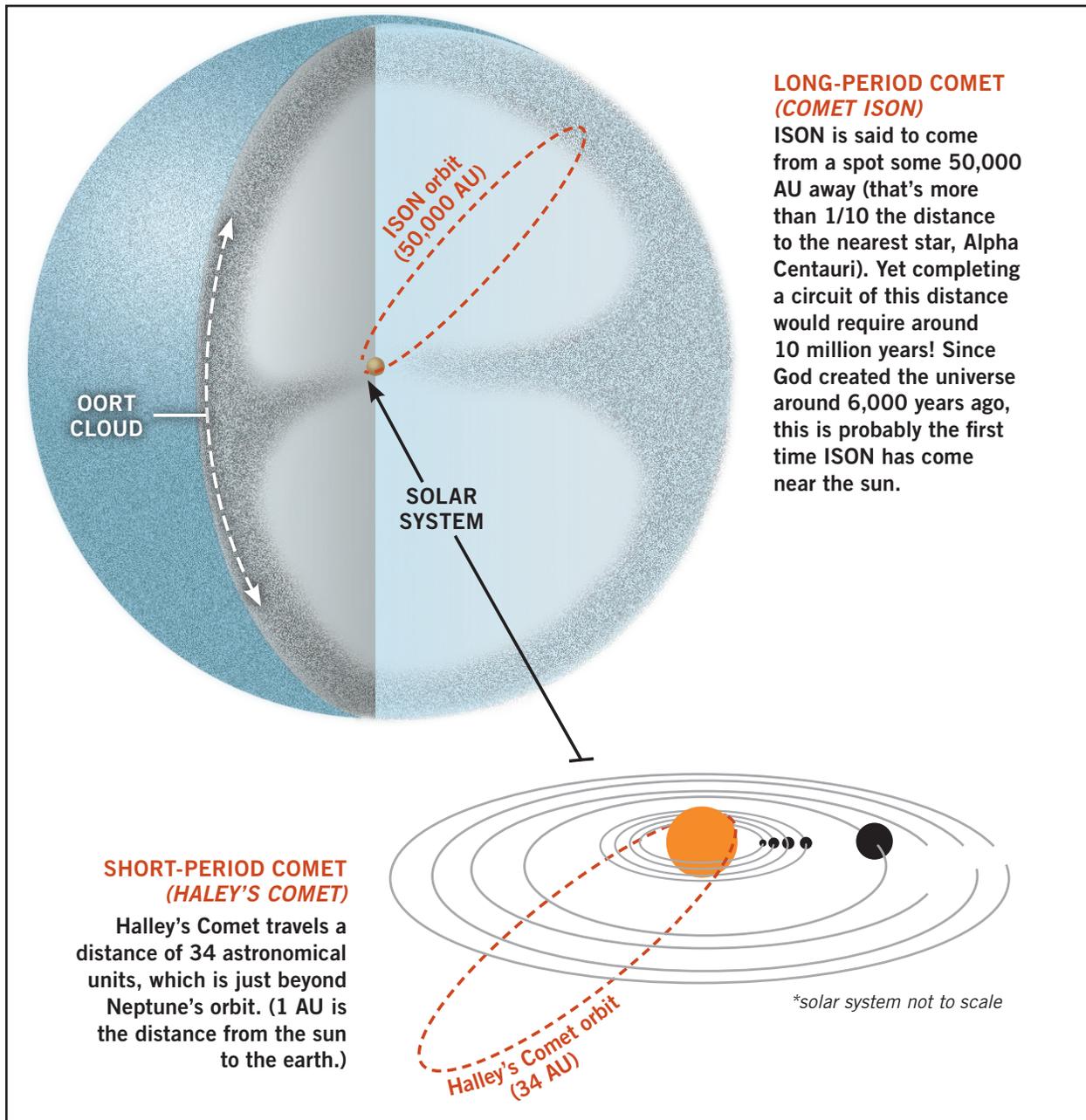
For further study:

<http://www.answersingenesis.org/articles/creation-debate/bible-predictions-scientific-discoveries>

Reaching Beyond

9. If a comet does not disintegrate, how soon will it reappear where we can see it from earth?

ANSWER: The time it takes for a comet to complete an orbit varies greatly. It depends on several factors. The comet ISON that appeared in 2013 would require about 10 million years to complete one orbit of our sun. Since the Bible indicates God created all things about 6,000 years ago, Comet ISON's recent visit to our part of the solar system was its first. Halley's Comet, on the other hand, reappears



about every 76 years. Edmund Halley (1656–1742), using the mathematical principles of orbital mechanics that Isaac Newton had worked out, determined that the comets of 1531, 1607, and 1682 (which he had seen himself) were the same comet; and, in 1705, Halley correctly predicted its return in 1758. Counting backwards through history pinpoints several other recorded appearances. For instance, Halley’s comet appears in the Bayeux tapestry, which depicts the 1066 Battle of Hastings at which the Norman William the Conqueror killed England’s Anglo-Saxon King Harold.

For further study:

<http://www.answersingenesis.org/articles/am/v8/n4/comet-ison>

<http://www.answersingenesis.org/articles/tj/v15/n2/oort>

<http://www.answersingenesis.org/articles/tj/v16/n2/comets>

<http://www.answersingenesis.org/articles/2013/11/15/feedback-origin-of-comets>

<http://www.answersingenesis.org/get-answers/features/comet-ison>

10. What “laws of nature” control the movements of the planets and of comets? How were they discovered?

ANSWER: The laws of motion and the law of gravity describe the motions of the planets and of comets. German astronomer Johannes Kepler (1571–1630) discovered the laws that govern planetary motion. He believed that a wise Creator God would have created a universe that operated logically and looked for patterns that would explain what could be observed in the sky. He worked out the fact that the planets follow elliptical paths around the sun. Kepler’s laws of planetary motion provided the groundwork for Isaac Newton’s (1642–1727) discovery of the law of gravity and his mathematical descriptions of how the force of gravity and the laws of motion produce the elliptical orbits Kepler had described.

For further study:

<http://www.answersingenesis.org/articles/cm/v22/n3/gravity>

<http://www.answersingenesis.org/articles/cm/v15/n1/johannes-kepler>

<http://www.answersingenesis.org/articles/cm/v12/n3/sir-isaac-newton>

<http://www.answersingenesis.org/articles/am/v6/n1/chronology-wars>

Suggestions for Further Investigation

God designed the solar system, with the sun and the planets that orbit it, to be governed by forces that predictably keep the planets and even comets in predictable orbits. Johannes Kepler and Isaac Newton described the elliptical orbits that result. For further study, here a couple objectives for you to complete:

- Look up Kepler's three laws of planetary motion.
- Learn how to draw an ellipse (older students can learn how to mathematically describe an ellipse).

For further study about *Cosmos: A SpaceTime Odyssey*:

<http://www.answersingenesis.org/articles/creation-debate/review-cosmos-knowledge-conquered-fear>

<http://www.answersingenesis.org/articles/2014/03/11/review-cosmos-milky-way>

<http://www.answersingenesis.org/articles/creation-debate/review-cosmos-molecules-evolution>

<http://www.answersingenesis.org/articles/creation-debate/bible-predictions-scientific-discoveries>

<http://www.answersingenesis.org/creation-debate/cosmos-a-spacetime-odyssey>

For further study about comets:

<http://www.answersingenesis.org/articles/tj/v11/n3/comets>

<http://www.answersingenesis.org/articles/am/v8/n4/comet-ison>

<http://www.answersingenesis.org/articles/am/v7/n4/short-lived-comets>

<http://www.answersingenesis.org/articles/am/v1/n2/comets-tale>

<http://www.answersingenesis.org/articles/2013/11/15/feedback-origin-of-comets>

<http://www.answersingenesis.org/get-answers/features/comet-ison>

<http://www.answersingenesis.org/articles/tj/v15/n2/oort>

<http://www.answersingenesis.org/articles/tj/v16/n2/comets>