

Lesson 29

Infinity: Philosophy in Science

Objectives

- To define infinity
- To explain how infinity is interconnected with the study of science and philosophy

Notes to the Teacher

The subject of infinity demonstrates the interaction of philosophy and science. Since humans began to think about their existence, questions of infinity have arisen. What is time? When did the world begin? How big is space? Will the world end? These questions have troubled thinkers for a very long time. Throughout history, individual philosophers have addressed the areas directly related to infinity, such as existence, limits, and time. Tracing the ideas presented by philosophers throughout Western history provides insight to the individual periods of thought.

In this lesson, students discuss the topic of infinity in small groups and then examine the philosophical views of infinity throughout history. The lesson concludes with a mock protest between groups for and against the concept of infinity.

Procedure

1. Ask students to define the term *infinity* (*unlimited, endless, goes on forever, unbounded*). Ask: Why is the discussion of infinity a natural philosophical topic? (*hard to define, creates more questions that answers, requires abstract thinking*)
2. Fundamental questions involving infinity have confounded thinkers for centuries. Applying the concept of infinity to mathematics, human generations, the universe, and knowledge produces some difficult yet interesting problems. Distribute **Handout 49**. Allow sufficient time for students to complete it individually. Then have small groups discuss answers.

Suggested Responses:

1. Using the following algebraic equation results in .99999 (repeating) equaling 1.

$$\begin{array}{r} \text{Let } x = .99999 \text{ (repeating)} \\ 10x = 9.99999 \text{ (repeating)} \\ \underline{-x} \quad \underline{-.99999} \text{ (repeating)} \\ \hline 9x = 9 \\ x = 1 \end{array}$$

2. Humans possibly could die out because of our destructive nature; the theory of evolution has proved adaptability of the human species so it is possible that some human form of life could continue forever.
3. big bang theory; creationist theory in several religions, one example is the ancient Muslim kalam argument as described in syllogistic form by William Lane Craig in "The Finitude of the Past and the Existence of God":
 1. Everything that begins to exist has a cause of existence.
 2. The universe began to exist.
 3. Therefore, the universe has a cause of existence.¹
4. Yes, it is not possible to know everything. No, there is always something to learn.

3. Philosophers throughout history have examined the questions of existence, limits, and time—all these areas are addressed by infinity. Distribute **Handout 50**. Have students complete part A as homework or as an in-class activity. Discuss responses.

Suggested Responses:

Philosophers Who Support Infinity

- Anaximander created a boundless realm called *apeiron*.
- Zeno divided matter into smaller and smaller units that reached to infinity.
- Aristotle believed it was possible to perceive "potential" infinity.

¹"Is the Past Really Finite?," Govind, 4 January 2000, <<http://ccwf.cc.utexas.edu/~govind/stories/finitude.html>> 15 May 2003.

- *Lucretius said space was infinite.*
- *Plotinus professed that God or the one is infinite.*
- *St. Augustine believed there is no number to represent infinity.*
- *Descartes provided the mathematical connection of algebra and geometry found in infinite space through Cartesian coordinates.*

Philosophers Who Oppose Infinity

- *Pythagoras believed that "all is number" and that the universe is made up of finite natural numbers.*
 - *Plato said the Form of the Good is finite and definite.*
 - *Aristotle believed it is not possible to perceive "actual" infinity.*
 - *St. Thomas Aquinas believed that God is infinite but that he cannot create infinite things.*
 - *Locke said it is impossible to experience infinity; therefore, infinity doesn't exist.*
 - *Kant said that in order to perceive an infinite world it must be complete, which creates a paradox. Therefore, it is not possible.*
4. Have students answer the following questions. This may be done orally or in a quiz format. Review responses.
- True or False: All early philosophers supported the theory of infinity. (*false*)
 - True or False: All modern philosophers supported the theory of infinity. (*false*)
 - True or False: The idea of infinity can be examined as a steady progression of thought, with each philosopher building on the ideas of previous philosophers. (*false*)
 - How is possible to explain the philosophical inconsistencies for defining infinity? (*Each philosopher defined infinity to fit into his philosophical system.*)

5. Read the directions for part B of **Handout 50** together. Divide the class into two groups, one for infinity and one against it. Provide class time to prepare and present the demonstration.
6. Conclude by debriefing the demonstration. Ask: Why is it important to discuss the concept of infinity? (*It is as relevant as any other philosophical topic.*)

Problems in Infinity

Answer the questions that follow. Be prepared to share your answers.

1. Mathematics: Does $.99999999$ (repeating) equal 1?
2. Human Generations: Will the human race die out? Or will it go on indefinitely?
3. The Universe: Did the universe come into existence at a particular instant or has it always existed?
4. Knowledge: Is knowledge finite?

Lucretius (96–55 B.C.)

In *De Rerum Natura*, he gives the classic argument for the unboundedness of space: If someone went to the farthest boundary and threw a dart, it seems that “either the dart must go past the boundary, in which case it is no boundary of space; or the dart must stop, in which case there is something just beyond the boundary that stops it, which again means that the purported boundary is not really the end of the universe.”² Space is thus infinite.

Plotinus (A.D. 205–270)

“Plotinus was the first thinker after Plato to adopt the belief that at least God, or the One, is infinite. . . .”³

St. Augustine (A.D. 354–430)

“St. Augustine, who adapted the Platonic philosophy to the Christian religion, believed not only that God was infinite, but also that God could think infinite thoughts.”⁴

St. Thomas Aquinas (A.D. 1225–1274)

In *Summa Theologica*, Thomas Aquinas “used the fact that there was not a number to represent infinity as an argument against the existence of the actual infinite.”⁵ He deduced that numbers are created by counting units, and since a set must be numbered to be a set, it is impossible to have an infinite set of things since there is no number to signify infinity.

René Descartes (A.D. 1596–1650)

Descartes made the idea of actual infinity seem more reasonable because he connected algebra and geometry in his major philosophical treatise, *Discourse on Method*, which was published in 1637. Through the use of coordinates, Cartesian geometry focused attention on the infinite *space* in which geometry operated, rather than on geometric figures such as triangles and circles. By applying Cartesian geometry to the universe it made it even harder to imagine that the universe might have some sort of spatial limit.

John Locke (A.D. 1632–1704)

Locke believes that it is impossible to understand infinity and there is no possible way to do so because everything we experience is based on our senses. In other words, we have not seen, heard, touched, smelled, or tasted infinity. So, we do not possess the raw abilities in our minds to discover it.

Immanuel Kant (A.D. 1724–1804)

Kant argued in *The Critique of Pure Reason* that “the actual infinite cannot exist because it cannot be perceived. . . . This comes to the question often asked by philosophers: would the world exist if there were no intelligence capable for conceiving its existence? Kant says no. . . .”⁶

²Rudy Rucker, *Infinity and the Mind: The Science and Philosophy of the Infinite* (New York: Bantam Books, 1982), 16.

³*Ibid.*, 4.

⁴*Ibid.*

⁵O'Connor and Robertson, “Infinity.” <<http://www-groups.dcs.st-and.ac.uk/~history/HistTopics/Infinity.html>>.

⁶*Ibid.*

Part B.

Read the following scenario and prepare for the protest.

The President of the United States has just issued the following statement: "Due to its volatile and controversial nature, the concept of infinity is now declared to be subversive and a threat to our national security. Therefore, effective immediately, the practice and recognition of infinity is now prohibited and deemed illegal. Anyone participating in the practice or belief of infinity will be subject to punishment to the fullest extent of the law."

Understandably there is an emotional public reaction. Those in favor of banning infinity are breathing a sigh of relief and welcoming the peace of mind accompanying the absence of infinity. Those supporting infinity are outraged and are planning an aggressive demonstration to bring back infinity forever. The two sides will wave signs, chant slogans, make speeches, and play music.