Leonardo's Equivalence Principle: An Experimental Exploration of Gravity and Acceleration

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Despite the limited scientific tools available in his time, Leonardo da Vinci demonstrated remarkable ingenuity in investigating the laws of nature. In this lecture, Mory Gharib examines Leonardo's experiments and observations concerning the acceleration of falling objects.

Leonardo envisioned a vessel pouring water while moving horizontally at the same rate that the water fell vertically. He recognized that the two perpendicular motions—one produced by gravity and the other imposed by the experimenter—would trace an isosceles right triangle, with the falling water forming its diagonal. Along this diagonal, Leonardo wrote *Equatione di Moti*, or "equalization of motions," expressing his insight into the equivalence of these orthogonal accelerations.

In the article "Leonardo da Vinci's Visualization of Gravity as a Form of Acceleration," Gharib and his colleagues use Newtonian mechanics to confirm Leonardo's remarkably perceptive observation. The lecture places this work in the broader history of the equivalence principle—a cornerstone of Einstein's general theory of relativity, introduced into modern physics in the early twentieth century—and considers Leonardo's insight as a fascinating conceptual precursor to later thinking about gravity and acceleration.

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Mory Gharib is the Hans W. Liepmann Professor of Aeronautics and Medical Engineering at Caltech. He has received the G.I. Taylor Medal from the Society of Engineering Sciences, the Fluid Dynamics Prize from the American Physical Society, and five innovative technology recognition awards from NASA in Micro/nanotechnology. He has examined Leonardo's investigations into cardiovascular fluid mechanics and gravity using modern experimental and analytical methods. His group reconstructed a heart-valve concept drawn by Leonardo; the replica was exhibited in Leonardo da Vinci: Experience, Experiment and Design at the Victoria and Albert Museum, London (September 14, 2006-January 7, 2007). In 2023, Gharib, Chris Roh, and Flavio Noca published "Leonardo da Vinci's Visualization of Gravity as a Form of Acceleration" in Leonardo (MIT Press), analyzing Leonardo's notebook experiments on gravitational acceleration

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