

# New way to calculate how long it would take to fall through a hole in the Earth

March 26 2015, by Bob Yirka

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A composite image of the Western hemisphere of the Earth. Credit: NASA

(Phys.org)—Alexander Klotz a student at McGill University in Canada has calculated a new answer to the commonly asked physics question, how long would it take a person to fall all the way through the Earth? Instead of the commonly accepted 42 minutes, he claims it is 38. He has published his reasoning, math and conclusions in a paper published in *The American Journal of Physics*.

If someone were to drill a hole all the way through the planet, and then somehow manage to fall into it, how long would it take them to arrive on the other side? That is a physics question put to students every year, and those who give it expect the answer to be 42 minutes. But is that answer correct? Klotz says no and has the math to prove it, *Science* [reported](#).

The accepted answer of 42 minutes takes into account the constantly changing impact that gravity will have (and ignoring drag due to the presence of air) on the person falling, becoming less and less of a factor as the center of the Earth is approached then growing stronger and stronger as the person heads "up" against gravity on the other side. It is accepted that the speed attained during the descent on the first half of the journey would be significant enough to cause the person to continue moving against gravity on the other side of the planet, right up until the surface is reached.

But Klotz argues that it is time to start taking the different densities of the Earth's layers into consideration—after all, a lot of research has shown that our planet is a lot denser at the center than at the crust for example—and that of course would have an impact on the person falling through. He has used [seismic data](#) to calculate the different densities at different depths and has used that data to give a more accurate answer to the falling man question, stating that it would in fact, take just 38 minutes (and 11 seconds) to fall all the way through, not 42 and (12 seconds).

Interestingly, Klotz also notes that if [gravity](#) were to be assumed to be at a surface level constant throughout the duration of the trip, the math shows it would take just 38 minutes as well.

**More information:** The gravity tunnel in a non-uniform Earth, *Am. J. Phys.* 83, 231 (2015); [dx.doi.org/10.1119/1.4898780](https://doi.org/10.1119/1.4898780) . On *Arxiv*: [arxiv.org/abs/1308.1342](https://arxiv.org/abs/1308.1342)

## Abstract

This paper examines the gravity tunnel using the internal structure of Earth as ascertained from seismic data. Numerically, it is found that the time taken to fall along the diameter is 38 min, compared to 42 min for a planet with uniform density. The time taken to fall along a straight line between any two points is no longer independent of distance but interpolates between 42 min for short trips and 38 min for long trips. The brachistochrone path (minimizing the time between any two points) is similar in shape to the uniform-density solution but tends to reach a greater maximum depth and takes less time to traverse. Although the assumption of uniform density works well in many cases, the simpler assumption of a constant gravitational field serves as a better approximation to the true results.

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