How Would You Prove the Earth is Round?

Darrell D. Young

SUNY College at Buffalo

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How Would You Prove That
The Earth is Round?

Darrell D. Young, SUNY College at Buffalo, Buffalo, NY 14333

In this day of the Space Age, everyone knows that the earth is round. One merely has to look at a photograph taken from either the moon or an orbiting space satellite to prove the point. But suppose that you do not have a photograph handy or suppose that your viewer refuses to believe that the photo is real. Of course it is rather unlikely that the latter event would occur, but without such a visual aid how would you prove that the earth is round? This situation provides an excellent opportunity for the teacher to develop an inquiry into an old problem. In fact, this problem provides an opportunity for the science and history teachers to work together by first examining early ideas that caused people to believe that the earth was flat.

Because an idea is more likely to be accepted if multiple pieces of evidence can be provided in its support, I would like to suggest four different ways of proving the earth is round.

The first approach to this problem concerns the manner in which a receding ship disappears (Fig. 1A & B). If the earth is flat, then as the ship recedes it will slowly become smaller but you will always be able to see the same amount of the ship. If, on the other hand, the earth is not flat, then as the ship recedes from view it not only becomes smaller but you will see less of it. It is necessary to use a ship rather than a car because even though the land may look perfectly flat, it seldom is. This is also an opportune time to introduce and discuss the mechanics of vision.

![Fig. 1. A. Disappearance of a receding ship if the earth's flat. B. Disappearance of a receding ship if the earth is round.](image-url)
A second approach is to note the apparent change in altitude of the North Star (Polaris) when traveling either north or south (Fig. 2). The actual distance between the earth and the North Star is so great, that if the earth were flat it would be nearly impossible to measure any apparent shift in position without the use of some rather sophisticated equipment. But if the earth is round, one will quickly note an apparent change in the star’s position. This will actually amount to a $1^\circ$ change for every 70 miles traveled, either north or south. A good homework project is to determine the apparent altitude on paper by using maps or diagrams and then experimentally verifying at night by using a protractor and a plumb bob.

Fig. 2. The apparent change in altitude of the North Star when traveling either north or south in the northern hemisphere.

A third approach involves earth travel. In this approach, one merely travels north or south some predetermined distance from the equator and then proceeds east or west maintaining the same distance from the equator. If the earth is round, one will return to the original point of demarcation and successive trips at greater distances from the equator will be shorter.

And finally, an event which does not occur frequently, the lunar eclipse. During such an eclipse, the earth’s shadow can be seen to slowly drift across the face of the moon. This circular shadow will be repeated a
few minutes later as the moon once again reappears to our view.

These are four means of proving that the earth is round without satellite photographs. Can you or your class think of others?

Further Reading


A Fable

A student once needed a cube of metal which had to have a mass of 83 grams. He knew the density of this metal was 8.67 g/cc, which told him the cube’s volume. Believing that significant figures were invented just to make life in chemistry difficult and had no use in the practical world, he found the volume to be 83 g.\(8.67 \text{ g/cc} = 9.573 \text{ cc}\), and used a very big log table to find the cube root. He thus determined that the cube’s edge would have to be 2.097 cm. He took his plans to the machine shop where his friend had the same kind of work done the year before. The foreman said, “Yes, we can make this according to your specifications — but it will be expensive.”

“That’s okay,” replied the student. “It’s important.” He knew his friend had paid $35.00 and he himself had been given $50.00 out of the school’s research budget to get the job done.

He returned the next day, expecting the job to be done. “Sorry,” said the foreman. “We’re still working on it. Try next week.” Finally the day came, and our friend got his cube. It looked very, very smooth and shiney and beautiful in its velvet lined case. Seeing it, our hero had a premonition of disaster and became a bit nervous. But he summoned up enough courage to ask for the bill. “$500.00 and cheap at the price. We had a terrific job getting it right — had to make three before we got one right.”

“But — but — my friend paid only $35.00 for the same thing!”

“No. He wanted a cube 2.1 cm on an edge, and your specification called for 2.097. We had yours roughed out to 2.1 that afternoon, but it was the precision grinding and lapping to get it down to 2.097 which took so long and cost the big money. The first one we made was 2.089 on one edge when we finished, so we had to scrap it. The second one was closer, but still not what you specified. That’s why the three tries.”

“Oh.”

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