Round Earth vs. Flat Earth

Brief Summary

The Flat Earth Theory has recently gained popularity, thanks to a series of tweets and a song released by the rapper B.o.B. In the past few months, several people who believe the earth is flat have visited Space Odyssey. This guide is intended to help you understand their beliefs as well as the scientific evidence we have that the Earth is round. It is also intended to help prepare you to answer some of the most frequently asked questions about the shape of the earth. The most you can hope for is a respectful exchange of views, in which you both learn something. Sometimes that happens and it can be very enlightening experience for both parties. Sometimes, however, they are looking for confrontation rather than an honest discussion and will try to lure you into a debate, in which their rhetorical devices will be an advantage. Don't be frustrated.

The Flat Earth Theory

The leading flat earth theory says that Earth is a disk with the Arctic Circle in the center and a 150 ft. wall of ice (Antarctica) around the rim that holds in the oceans (see right). Some flat-earthers say that NASA employees guard the ice rim to keep people from falling off the edge of the disk.

According to this theory, the Sun and Moon are spheres that are 32 miles across and move in circles 3,000 miles above Earth. Stars move in a plane 3,100 miles above the surface of Earth. Flat-earthers derive this size for the Sun from the geometry of crepuscular rays. The Sun acts like a spotlight and illuminates different portions of the earth over a 24-hour cycle.

Flat-earthers also believe that gravity is an illusion. Some believe that objects just fall. Others say that the disk of Earth is accelerating upward at 32 ft/s² (9.8m/s²). It is being driven upward by a mysterious force (some call this energy “dark energy,” others “aether wind”). However, there is some disagreement among flat-earthers whether this constant acceleration would violate Einstein’s theory of Relativity and cause the Earth to eventually be traveling at speeds faster than the speed of light (Note: at this acceleration the earth would be traveling faster than the speed of light in 354 days).

What about the photos of Earth from space? They are Photoshoped according to the Flat Earth Society. They note that photos are too easily manipulated to be considered credible evidence.

Image Credit: http://wiki.tfes.org/Frequently_Asked_Questions
They also site “quirks” of modern cameras that can cause things to look curved as another possible reason photos of earth may look curved.

They also do not think humans have gone to space. According to the Flat Earth Society FAQ page, the reason people who have been to space have not seen a disk shaped earth is as follows: “The most commonly accepted explanation of this is that the space agencies of the world are involved in a conspiracy faking space travel and exploration.” However, they go on to say, “…please note that we are not suggesting that space agencies are aware that the earth is flat and actively covering the fact up. They depict the earth as being round simply because that is what they expect it to be.” (http://wiki.tfes.org/Frequently_Asked_Questions)

It is important to note that flat-earthers are generally not anti-science. The Flat Earth Society is a strong supporter of climate science and believes the evidence for climate change is strong. Most also accept evolution, relativity, and other main tenets of science. They also call their process and evidence for a flat earth “alternate science.” Generally, they are following a process called the “Zetetic Method,” which was developed in the 19th century by a flat-earther as an “alternate scientific method.” This method puts first hand sensory observations as supreme evidence.

**Scientific Evidence the Earth is Round:**

**Varying Constellations with Latitude**

On a flat earth, the same constellations would appear in the same positions no matter where you were on earth. Instead, we see that as we move north or south from the equator, the constellations move closer to the horizon and eventually disappear and others appear. The northern and southern hemispheres also have very different constellations.

This can also be tested without having to travel to the southern hemisphere. Find the North Star, Polaris (located in the Little Dipper). Without any tools, you can estimate its height relative to the horizon by making a fist and holding it out at arm’s length. The size of our fist at this distance is about 10 degrees. Measure that height. Now measure it again when you have traveled either north or south (for this rough estimate, it is best done with more than 10 degree change in latitude). Notice that as you travel further north, Polaris is higher in the sky, and as you travel south, it is lower in the sky. This could not happen on a flat earth.
The Flat Earth Society does not have an official explanation for this.

**Shadow Lengths**

The ancient Greek astronomer Eratosthenes knew that there was a well in Syene (now known as Aswan, Egypt) that on noon on the summer solstice sunlight reflected off the well’s bottom. However, at the same time, on the same day, in Alexandria, columns and sundials cast shadows. By measuring the angle of the shadows in Alexandria, he was not only to prove that the Earth was round, but also measure the circumference of the Earth. True, Eratosthenes was a little off, Alexandria and Syene weren’t exactly on the same longitude (2 degrees off) and his distance between the two cities was an estimate.

However, this is an experiment that is easily reproduced in modern day. It can be done with any two locations that are on the same longitude line, or meridian, that are at least 200 miles apart. For example Seattle and San Francisco. If you were able to place a meter stick in the ground and measure the angle of the shadows at noon on the same day (or even back-to-back days) in the two cities, you would find that the shadows are at different angles, which can only happen on a spherical earth.

**Ships on the Horizon**

Ships are one example of this phenomena, but one of the most easily observed. When a ship appears on the horizon, it doesn’t simply appear like it would if you were on a flat earth. Instead, it seems to rise out of the waves. Alternately, if the ship were heading away from you, it would disappear starting at the hull, looking like it was sinking into the water. This is due to the curvature of the earth.

You could do this thought experiment (or perhaps a real experiment if you were on a picnic) imagining an ant crawling along the surface of orange. As you look at the orange head on and the ant comes into your field of view, you would see its body rising up from the “horizon” due to the curvature of the orange. If this were done on a long, flat surface, the ant would just appear at the point where your eyesight was good enough to see it.

Note, flat-earthers will argue that this is simply not true. They say that if you had a sufficiently powerful telescope and looked at the ship sailing off into the horizon that you would be able to
see the hull. However, this is an experiment that one could easily replicate and find that it doesn’t work.

**Time Zones and When the Sun is in the Sky**

Both flat-earthers and globularists (the term flat-earthers use for folks who believe the earth is round) agree that time zones exist. For instance, as this is written, it is noon in Colorado and the Sun is at its highest point in the sky for the day. In London, it is 7:00 p.m. and the sun is getting ready to set, and in Mumbai it is 12:30 a.m. and the sun has long ago set.

Flat-earthers explain that this is caused by a sun that is 32 miles across going around in a circle about 3,000 miles above the earth and acting as a spotlight illuminating different parts of the earth at different times of the day. However, even if the sun was not illuminating part of earth or sending out rays of light in all directions (they argue though while the sun is spherical, it only shines down toward earth) it would still be visible in the sky.

![Image Credit: http://www.popsci.com/10-ways-you-can-prove-earth-is-round](image1)

This is a phenomena that we don’t observe. However, a spherical earth rotating does match our observations of the day and night cycle.

**Seeing Further From Higher**

In movies we often see people climbing trees or getting on roofs to see further. Many times, this is associated with getting above things that are obstructing their view, such as buildings or trees. However, even without any obstacles in your view, climbing up higher will actually allow you to see further, as you can see in the images below. This can only happen on a curved earth.

In the images below you can see two people looking out at the horizon, one on a hill that is directly above the other. The cone and lines represent their field of view. You can see that on a flat earth, both observers can see the tree. However, on a round earth, only the observer who is on the hill can see the tree.

![Image Credit: http://www.popsci.com/10-ways-you-can-prove-earth-is-round](image2)
happens with ships on the horizon). When the last rays start to disappear, jump up and you will be able to see the sunset again.

Other Evidence

There is more evidence that the earth is round. Flat-earthers do have counter arguments to these prepared, however.

For instance, lunar eclipses are a great example to prove that the Earth is round. If you have watched a lunar eclipse or seen photos of one, you will notice that the shadow cast by the earth on the moon is round. This is true no matter where you are observing the eclipse from and is one piece of evidence that the earth is spherical. However, flat-earthers argue that it is not the earth casting a shadow on the moon. Some go as far to say that there is an invisible, spherical anti-moon that is eclipsing the moon.

We also know from physics that for gravity to be consistent on all places on the surface of the earth that everywhere on the surface must be equidistant from the center of gravity, which implies a spherical earth. However, gravity is just an illusion according to flat earth theory.

Background materials (websites, videos, articles, digital collections links)

- PBS, DIY Experiments to Prove Earth is Round: [http://www.pbs.org/newshour/updates/7-diy-experiments-b-o-b-the-earth-is-round/](http://www.pbs.org/newshour/updates/7-diy-experiments-b-o-b-the-earth-is-round/)
- 8 Reasons We Know the Earth Isn’t Flat: [http://nerdist.com/8-reasons-we-know-the-earth-isnt-flat/](http://nerdist.com/8-reasons-we-know-the-earth-isnt-flat/)
- 10 Ways You Can Prove Earth is Round: [http://www.popsci.com/10-ways-you-can-prove-earth-is-round](http://www.popsci.com/10-ways-you-can-prove-earth-is-round)
- Flat Earth Society Wiki: [https://wiki.tfes.org/The_Flat_Earth_Wiki](https://wiki.tfes.org/The_Flat_Earth_Wiki)
- The Flat Earth Society: [https://theflatearthsociety.org/](https://theflatearthsociety.org/)