

Although there are still a few people who think that the Earth is flat, nearly everyone knows that our planet is a sphere. But, as with other facts that you will learn this year, the most important issue is not what you know, but *how* you know it is true.

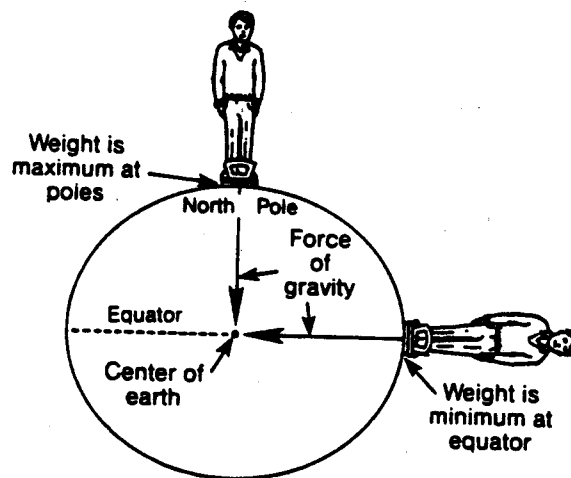
It was obvious to the ancient people that Earth must be flat. If it were not, people on the other side would fall off. When we began to understand how gravity pulls us toward the center of the Earth, we could better comprehend a round planet.

In fact, gravity has given us an important method to determine the exact shape of the Earth.

An argument against the round Earth.

Gravity becomes weaker the further you are from the center of the Earth. It is measurably weaker on high mountains than at sea level. Over the whole Earth, the strength of gravity varies by about 1%. Gravity is slightly stronger at the poles than it is near the equator. There are two reasons for this. Firstly, the spin of the Earth creates a slight centrifugal force. But, more importantly, the Earth bulges slightly at the equator. So a person at the equator is about 20 kilometers farther from the center of the Earth than a person at the poles.

The true shape of the Earth has been described as an oblate spheroid, very slightly flattened at the poles and very slightly bulging at the equator. Please note that the flattening has been greatly exaggerated in the diagram to the right.



Because gravity is *slightly* greater at the poles, we know that the Earth bulges a little at the equator. (The bulge is greatly exaggerated in this diagram.)

(Side)



Ships seem to disappear hull first as the sail "over the horizon".

(Side)

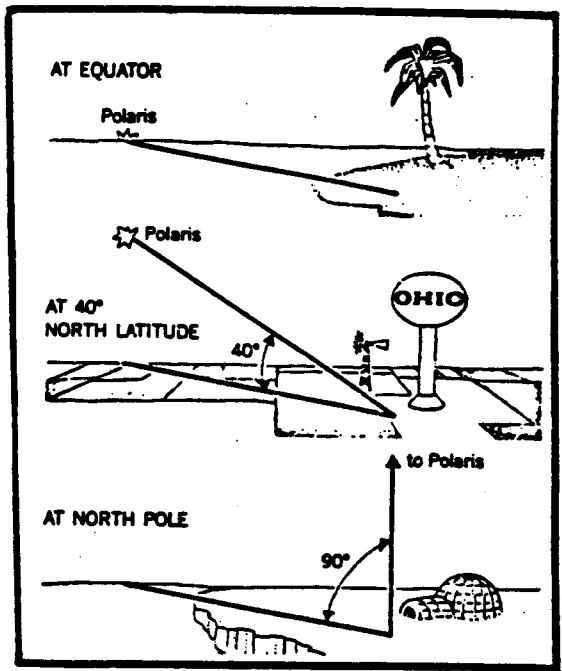
Long before Columbus, people noticed that a distant ship seems to sail "over the horizon." On a clear day, and especially through a telescope, the ship can be seen to disappear from the bottom up, as it "sinks" below the horizon.

This effect can be seen in any compass direction. It is caused by the curvature of Earth's surface. For this reason, most educated people have believed that the Earth is really a sphere for over two thousand years.

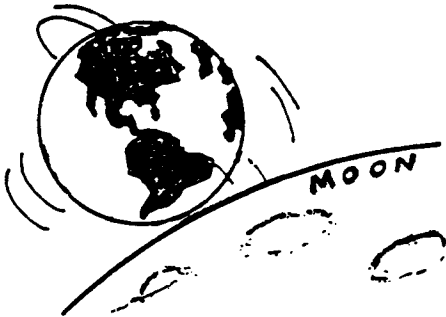
A third way to determine the shape of the Earth is to make observations of stars and planets. If people over the whole Earth try to observe the sun at the same time, some will see it, and some (where it is night) will not. For some people, the sun will be high in the sky. For others it will be near the horizon. When we account for all of these observations in a logical model, we can determine that the Earth must be a sphere.

On a spherical planet, when it is noon here, it must be midnight on the opposite side of the Earth. 90° to the east or west, the time will be 6 AM or 6 PM.

Consider the diagrams to the right. A person at the equator will observe the North Star along the horizon. As he travels northward, Polaris will rise in the sky. Finally, at the North Pole, it will be directly overhead.



When the moon moves into the shadow of the Earth, we observe an eclipse of the moon. Because the moon is smaller than Earth, we cannot see the whole shadow. But the edge of the shadow is always round. The only shape that has a shadow that is always round is a sphere. In this way, observations of lunar eclipses support the spherical shape of the Earth.



The Earth looks perfectly round.

So far, we have considered only indirect evidence. The space age has allowed us to make direct observations and photographs of our home planet. It was no surprise to observe the nearly spherical shape of planet Earth. In fact, the Earth is so close to a perfect sphere that we cannot detect the slightest flattening without the use of precision instruments.

Although we can measure the very slight flattening of our oblate spheroid, it is so close to being a perfect sphere that observations of the Earth from any point of view make the Earth look perfectly round.

A. State four ways to determine the shape of the Earth, without leaving the ground.

1. _____
2. _____
3. _____
4. _____

B. How close to a perfect sphere is the Earth's true shape? _____

C. At the equator, how high in the sky is the North Star? _____

D. Why do things weigh slightly more at Earth's poles, than they do at the equator?
