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## How Thick is the Atmosphere?

**By:** Martin J Ruzek, Universities Space Research Association, 8426 Polifka Road,  
Whitelaw WI 54247 e-mail: ruzek@usra.edu

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We've all seen pictures of the Earth and its atmosphere as a series of concentric circles, showing the troposphere, stratosphere, ionosphere, etc., often looking like a bullseye target with the solid Earth in the middle. But if we were to draw that picture to scale, what would it really look like?

Let's start with the solid Earth, which has a radius at the equator of about 6378 kilometers (or 3963 miles). With a compass (or a computer) draw a circle scaled to fit on a single sheet of paper to represent the Earth. If a distance of 1 cm on your paper equals 1000 km on Earth, then the Earth is drawn as a circle with a radius of 6.378 cm

The atmosphere is interesting stuff. One of the things it happens to do is get thinner the higher you go. At sea level, the atmosphere pushes down with a weight of about 1 kg per square centimeter (or about 14.7 pounds per square inch). As you move up into the atmosphere, while you are climbing a mountain or riding in an airplane for example, the atmospheric pressure begins to decrease. When you reach an altitude of about 5,500 meters (about 18,000 feet), the air pressure is only about one half of what it was at sea level, which means that about half of the Earth's atmosphere is already below you. Does that mean that you will pass through the other half of the atmosphere and be in the vacuum of space if you rise another 5,500 meters? Fortunately, no, since most commercial passenger jets fly at an altitude of 11 - 13,000 meters. There is still enough air at that altitude to keep jet engines running and to flow over the wings to create enough lift to keep the plane aloft. But the air pressure at 11,000 meters is only about one quarter of that at sea level. In other words, for roughly each 5.5 km you ascend, the atmospheric pressure halves. By the time you have reached an altitude of 30 km (on your way into orbit aboard the space shuttle, for instance), you have risen above 99% of the Earth's atmosphere, and by 100 km, 99.9999% of the atmosphere is below you.

So, lets see where this "top" of the atmosphere goes on your scale drawing. (It's really not the top, since molecules of air continue to extend into space, but virtually all of the atmosphere will lie below this line) If your drawing uses the scale of 1 cm = 1000 km, you need to add another circle with a radius just 1 mm larger than the circle representing the Earth to show 100 km altitude.

I think you will be able to see from your drawing just how thin the Earth's atmosphere is. The Earth is a big place, but the atmosphere that supports life, creates our weather and keeps us protected from harmful radiation is just a small portion of the planet we live on.

### Other activities:

Make a graph plotting atmospheric pressure along the horizontal axis, and altitude along the vertical axis. Does the atmosphere ever go away completely?