

Air: A High-pressure Fluid

1. One amazing thing about living on earth is that we are constantly walking around in a high-pressure fluid – a substance with mass and no shape. The air around us is composed of several different elements in a gaseous state. In this gas, the [atoms](#) and molecules of the elements fly around freely, bumping into each other and everything else. As these particles collide against an object, each of them pushes with a tiny amount of energy. Because there are so many particles in the air, this energy adds up to a considerable pressure level (at sea level, about 14.7 pounds of pressure per square inch (psi), or 1 kg per square centimeter (kg/cm²!).

2. The [force](#) of air pressure depends on two things:

- The rate of [particle collision](#) – if more particles collide in a period of time, then more energy is transferred to an object.
- The force of the impact – if the particles hit with greater force, more energy is transferred to an object.

These factors are determined by how many air particles there are in an area and how fast they are moving. If there are more particles, or if they are traveling more quickly, there will be more collisions, and so greater pressure. Increasing particle speed also increases the force of the particle's impact.

3. Most of the time we don't notice air pressure because there is air all around us. All things being equal, air particles will disperse evenly in an area so that there is equal air density at every point. Without any other forces at work, this translates to the same air pressure at all points. We aren't pushed around by this pressure because the forces on all sides of us balance one another out. For example, 14.7 psi is certainly enough to

knock over a chair, or crush it from the top, but because the air applies roughly the same pressure from the right, left, top, bottom and all other angles, every force on the chair is balanced by an equal force going in the opposite direction. The chair doesn't feel substantially greater pressure from any particular angle.

4. So, with no other forces at work, everything would be completely balanced in a mass of air, with equal pressure from all sides. But on Earth, there are other forces to consider, chiefly [gravity](#). While air particles are extremely small, they do have mass, and so they are pulled toward the Earth. At any particular level of the Earth's atmosphere, this pull is very slight -- the air particles seem to move in straight lines, without noticeably falling toward the ground. So, pressure is fairly balanced on the small scale. Overall, however, gravity pulls particles down, which causes a gradual increase in pressure as you move toward the earth's surface.