Flipping Physics Lecture Notes:
Pressure – Billy's Physics Dream
http://www.flippingphysics.com/pressure.html

If you pound a hammer against a nail with the nail oriented with the flat head of the nail against a wood board, the nail will not pierce the wood board. The reason why has to do with pressure!

Pressure equals Force over Area: $\text{Pressure, } P = \frac{F}{A}$

Example: You can determine the pressure caused by your feet pressing against the ground. For me the numbers are:

The area of one foot is roughly a 21 cm by 7.0 cm rectangle:

$$A_{\text{foot}} = 21cm \times 7.0cm \approx 147cm^2$$

However, let's have all our numbers in base S.I. units. So, let's convert to square meters.

$$A_{\text{foot}} = 147cm^2 \times \frac{1^2m^2}{100^2cm^2} = 0.0147m^2 \Rightarrow A_{2\text{ feet}} = 2 \times 0.0147 = 0.0294m^2$$

And I actually have two feet, not just one.

The weight of my body in newtons: $\text{weight} = 170\text{pounds} \times \frac{4.448N}{1\text{pound}} = 756.16N = F_g$

And we can determine the pressure on my two feet caused by the weight of my body while I am standing at rest.

$$P_{2\text{ feet}} = \frac{F_g}{A_{2\text{ feet}}} = \frac{756.16}{0.0294} = 25720\frac{N}{m^2} = 25720Pa \times \frac{1kPa}{1000Pa} \approx 26kPa$$

Note: Pressure is measured in newtons per square meter and those are called pascals in honor of Blaise Pascal, a 17th century French physicist, mathematician, and inventor.

- $\text{Pascal, } 1\,Pa = 1\frac{N}{m^2}$

Also, pressure is often measured in kilopascals, kPa, just like kilometers and kilograms.

$$P_{1\text{ foot}} = \frac{F_g}{A_{2\text{ feet}}/2} = (2)\frac{F_g}{A_{2\text{ feet}}} = (2)P_{2\text{ feet}} = (2)(25720) = 51440\frac{N}{m^2} \approx 51kPa$$

And going back to the nail example, if you turn the nail around so the pointy side is on the wood board, the area in contact with the wood board is significantly decreased, which means, using the same force from the hammer, the pressure from the nail on the wood board is significantly increased, and the nail will pierce the wood board!

A few additional tidbits:

- The equation definition for pressure actually has the force perpendicular to the surface in it, not just the force. Any force component of the force which is parallel to the surface does not cause any pressure on the surface. $P \equiv \frac{F_\perp}{A}$
- Pressure is a scalar. Pressure does not have direction, it has only magnitude.