- This kind of wave is known as a **longitudinal** wave – because atoms in these media are displaced *longitudinally* (*i.e*. parallel) to the direction of propagation of the disturbance, as the disturbance passes through a given region of the medium.

- Thus, sound waves that we can hear with our own ears are the result of physical vibrations of matter – collective, vibrations of atoms/molecules.

- Food for Thought: Is it possible to "hear" the sound associated with *one* atom or one molecule vibrating? – Answer: yes – *e.g*. via use of various of today's nanoscale technologies! But atomic/molecular vibrations "heard" not as sound waves – the frequencies associated with quantum-mechanical vibrations are usually *very* high (*e.g*. *GHz* {10^9 *Hz*} – molecular or *THz* {10^{12} *Hz*} – atomic), compared to *e.g*. 20 *KHz*. The high frequencies would need to be scaled down (by a huge amount) in order for us to Hear/perceive them – in the audio frequency range (20 *Hz* – 20 *KHz*).

- Sound waves propagating in a physical medium propagate with a characteristic speed in that medium – known as the **speed of sound**.
  - Speed of sound in (dry) air (at sea level) is v_{air} ~ 345 meters/second (m/s)
  - A more accurate relation is: $v_{air} \sim 331.4 + 0.6*T$ m/s where T is the temperature of the air (in Celsius degrees).
  - Practical problem: If lightning strikes the ground 1 mile away from you (= 5280 ft = 1609.3 *m*), how long after you see the lighting will you hear the thunder? Distance (*m*) = speed (m/s) * time (s), *i.e*. $d = vt$, so therefore $t = d/v$. The answer is $t \sim 4.7$ *s*.

- Sound waves propagating in a physical medium also carry **energy**, *E* (Joules, *J*) in the wave and also carry **momentum**, *p* (*kg-m/s*) in the wave.

- Sound waves propagating in a physical medium exert a **force**, *F* (Newtons, *N*) on the atoms/molecules in the medium in the vicinity of the wave disturbance.
  - In a gas, such as air, these forces create local hi/lo variations in the density ρ and pressure P (via ideal gas law: $PV = NRT$).
  - True also for fluids – not truly incompressible….
  - Solids are in fact *elastic* – atoms bound together (via *EM* force!) making up the solid in some kind of 3-D lattice arrangement of atoms in the solid deforms/stretches as the acoustic disturbance passes through the solid material.