Waves

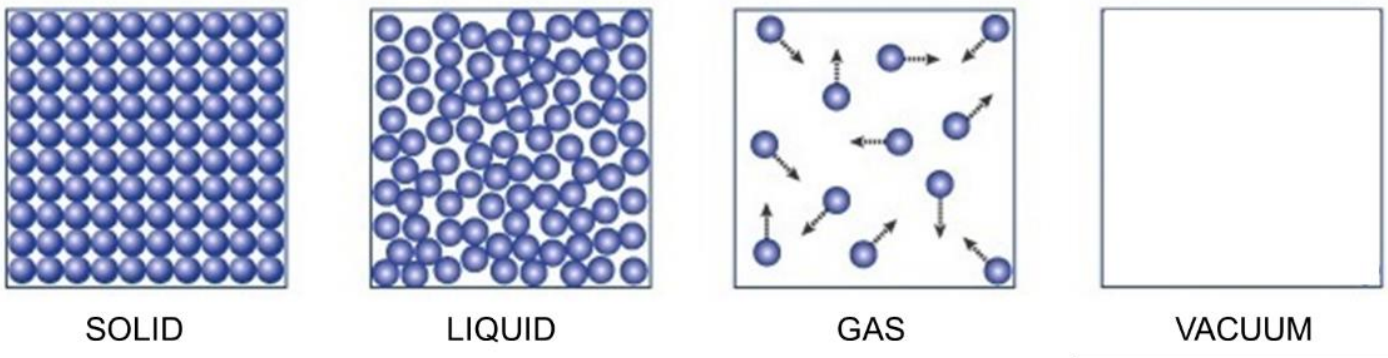
1. Sound

CONCEPT 3

HOW SOUND WAVES TRAVEL

NOTES

Most of the sounds we hear are transmitted by vibrating air particles (particles of gas). Sounds can also travel through solids and liquids. Sound waves need particles of matter to transmit energy. As particles vibrate, the energy is passed on to adjacent particles and carried in the form of a wave. Sounds cannot travel through a vacuum (e.g. space) because there are hardly any particles in it.

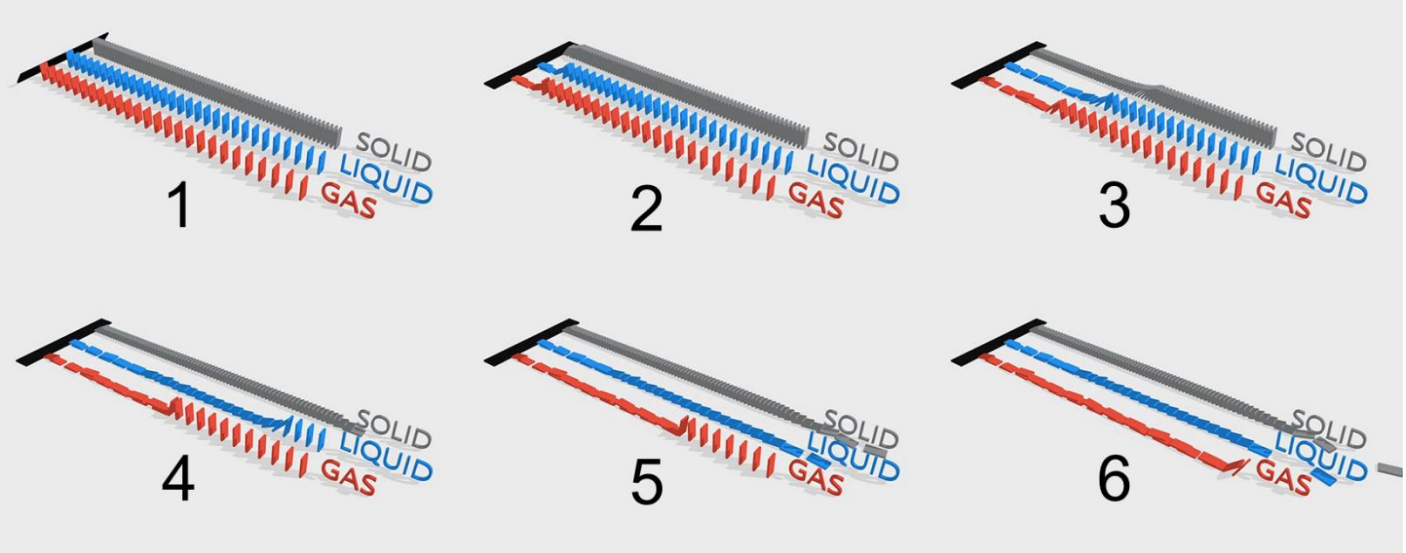


We need to refer to Topic 5.1 Concept 1 to understand how particles are arranged in solids, liquids and gases.
The following diagram is a summary and shows how close the particles are to each other in each material. Sounds travel much quicker in solids because they are packed close together. The vibrating particles can collide with neighbouring particles and bounce back very quickly. In liquids particles are also very close together and sound also travels quickly. The greater speed within a solid is due to the intermolecular forces between particles – these are not present in liquids.

Sound travels much quicker in solids and liquids than in gases because gas particles are much further apart and the collisions between particles is less frequent. This is also the reason why sound cannot travel very far in air before becoming too quiet to hear. In addition to travelling quicker, sounds can travel much further through solids and liquids than they can in gases.

Why can sound not travel through a vacuum?

A nice to way to visualise why sound waves travels quickest in solids then liquids then gases is to imagine particles as dominos. The dominos fall at the same speed (or vibrate with same amplitude) but because they are closer in solids the energy will transfer to adjacent particles in a quicker time.



This table shows the speeds that sounds travels through different materials. Please note that these speeds are not absolute values because the speed can vary depending on the temperature of the material sound is travelling through.

Material	Speed of sound (m/s)
air	343
carbon dioxide	259
copper	5010
diamond	12000
lead	1960
oxygen	316
water	1482
steel	5960