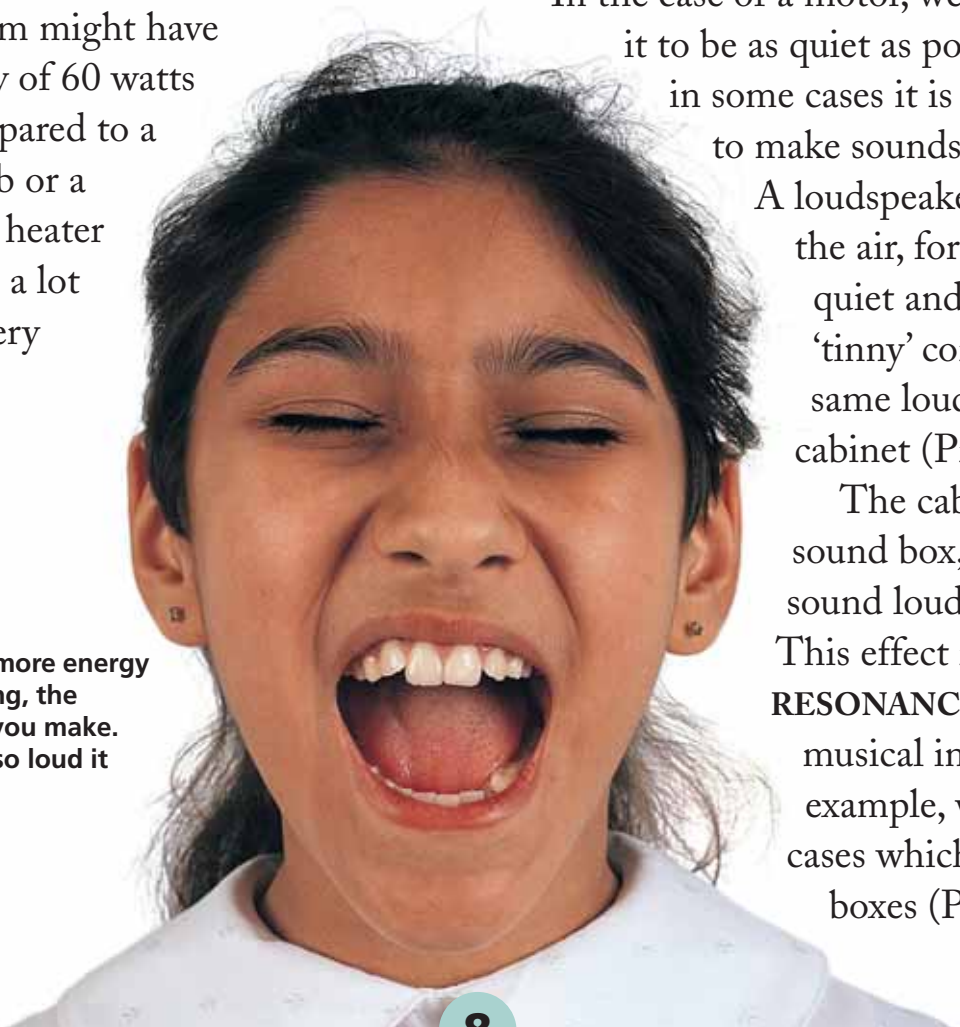
How loud is a sound?

Sounds can vary in loudness depending on how much energy is in the waves.

Sound is a form of energy, just like light or heat. The more energy there is in a sound wave, the bigger the size of each vibration and the louder the sounds (Picture 1). Sound energy is measured in watts, just like other forms of energy.

Ears and loudness

We are very sensitive to loudness, or sound level, so only small amounts of energy are needed to make a sound that we think is loud. A powerful hi-fi that would produce a deafening sound in a room might have a sound energy of 60 watts (W). But compared to a 60W light bulb or a 2,000W room heater this seems like a lot of sound for very little energy.



(Picture 1) The more energy you put into singing, the louder the sound you make. Eventually it gets so loud it becomes a scream.

Making sounds louder and richer

The loudness of a sound depends on how much air the vibrating object can set in motion. If, for example, you hold a small electric motor in the air while it is running, it will be very quiet. If you then put the motor on a metal box, it will become much louder because the whole box will be vibrating and more air has been set in motion. In this way a small sound has been made louder, or **AMPLIFIED**.

In the case of a motor, we usually want it to be as quiet as possible, but in some cases it is important to make sounds louder.

A loudspeaker held in the air, for example, is quiet and sounds very 'tinny' compared to the same loudspeaker in a cabinet (Picture 2).

The cabinet acts as a sound box, making the sound louder and richer. This effect is called **RESONANCE**. Many musical instruments, for example, violins, have cases which act as sound boxes (Picture 3).

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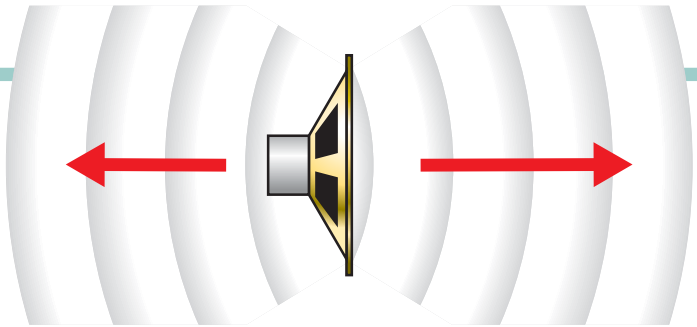

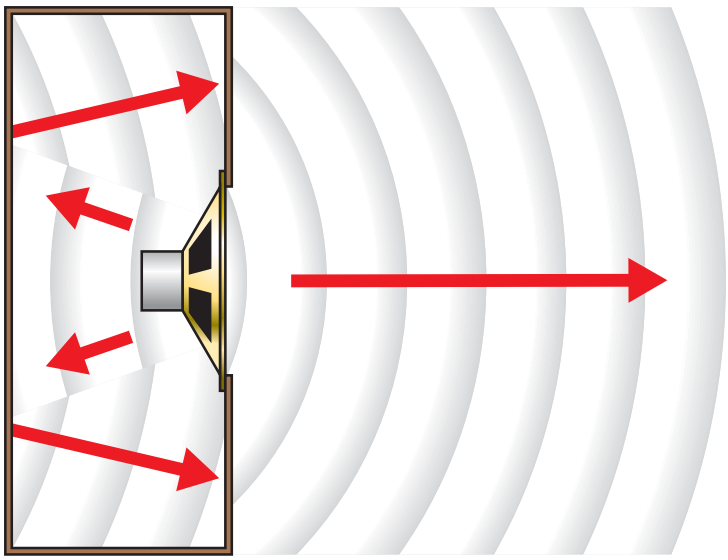

▲ (Picture 2) A loudspeaker sends out waves in front and behind. The cone of the speaker cannot vibrate well enough on its own, so the sound is quiet and 'tinny'. If the speaker is placed in a box, the box also vibrates. Because the box is bigger, the sound is louder and the box is better able to send out low notes. The sounds behind the loudspeaker bounce around inside the box and, if the design of the cabinet is right, they can add even more to the sound.

Decibels

People measure sound loudness by a unit called a **DECIBEL** (dB). Zero decibels is the faintest sound we can hear, and 130dB is a sound so loud that it causes pain. Sound above 120dB is dangerous.

A television in a room may give out 30dB, while street traffic may be 70dB. People standing near to loudspeakers in concerts may get over 120dB. This is enough to make them temporarily deaf and may cause hearing damage.

Drills and other machinery can also produce loud sounds, which is why people using them wear protective ear defenders (Picture 4) or use earplugs.

▶ (Picture 3) The body of a double bass is its sound box. Notice that the body has openings. These allow sound to get in and out of the sound box.

▶ (Picture 4) Ear defenders reduce sound.

Summary

- A sound can be made louder by using a sound box.
- Sound is a form of energy. The more energy you put in, the louder the sound.
- Very loud sounds can be dangerous to your health.

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